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PLANT ENGINEERING IN INDUSTRY

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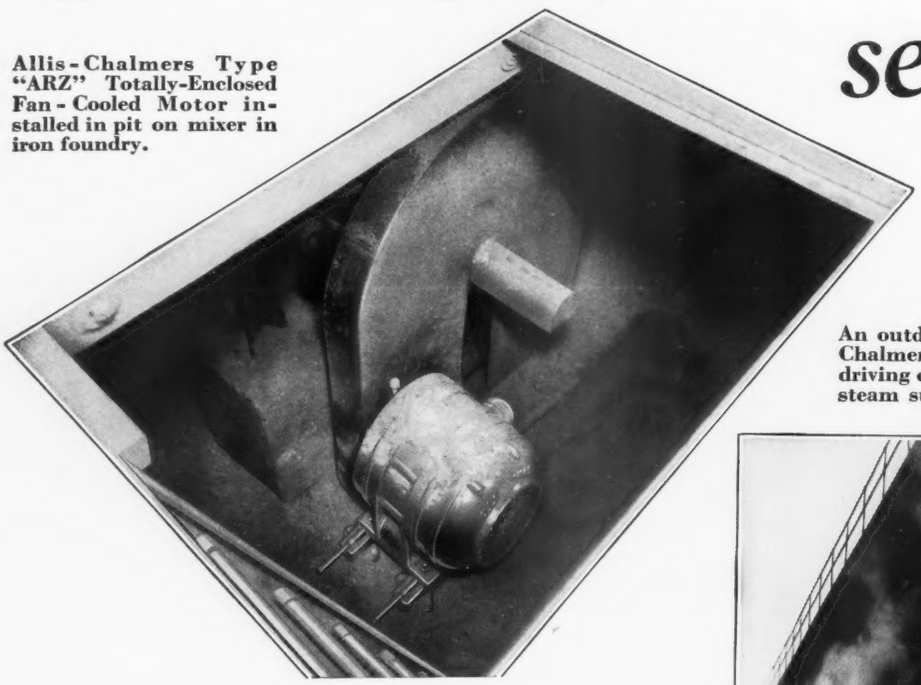
For Cover Story see page 90

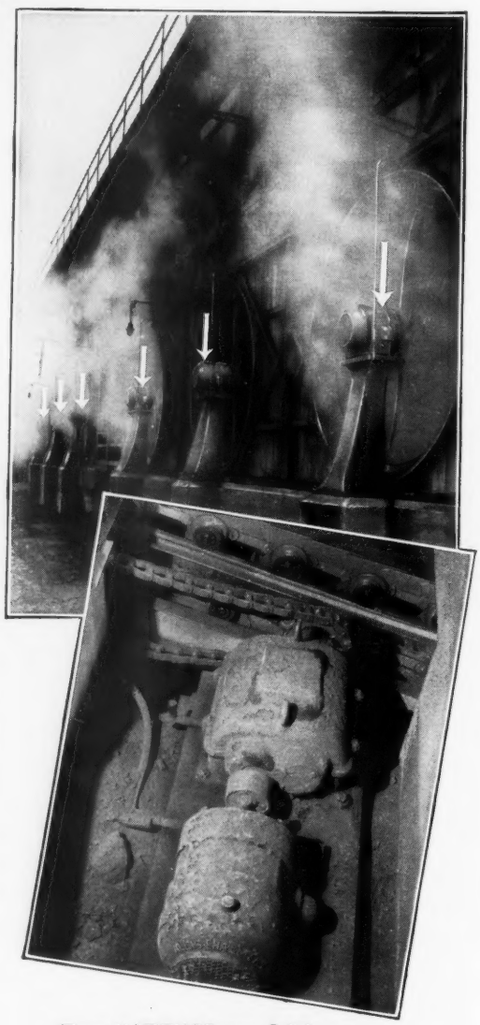
FEBRUARY, 1930

Speaking of severe service—



Allis-Chalmers Type "ARZ" Totally-Enclosed Fan-Cooled Motor installed in pit on mixer in iron foundry.

An outdoor installation of Allis-Chalmers Type "ARZ" Motors driving cooling tower fans. Note steam surrounding motors.



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ALLIS-CHALMERS MOTORS

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Volume 88, Number 2

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It's easy enough to agree that *now* is the time to prepare for cheaper production. But what are the things that must be done? The first article in this issue, page 67, tells you.

A repair man reached for a wrench in the dark, got hold of a switch handle instead, closed the switch and started the machinery on which repairs were being made. Result, injuries to men and equipment that could have been prevented by proper illumination. Lighting the Way to Fewer Accidents, page 81.

"Are You Ready for the Question?" gets a new name in this issue. Now it is the "Plant Engineer's Forum." Do the contributors know what they're talking about?—And how! Page 84.

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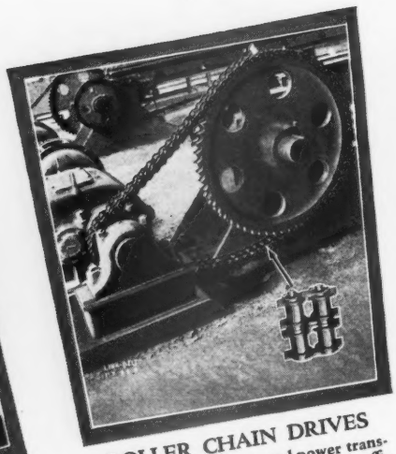

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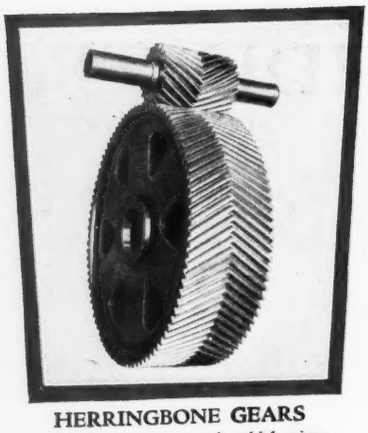

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PLANT ENGINEERING IN INDUSTRY
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Volume 88 CHICAGO, FEBRUARY, 1930 *Number 2*

The Maintenance Engineer Is the Man of the Hour

. . . In 1930 the maintenance engineer is coming into his own. He is the man of the hour, by nomination of Herbert Hoover, president of the United States.

. . . Maintenance of prosperity is the end sought. Business in years to come must go ahead on a more stable, even basis, with fewer ups and downs. An even flow of profitable production and efficient distribution is sought.

. . . Never has the executive head of our government addressed maintenance engineers in such unmistakable terms as were employed by the President in the message which is quoted in part in the article beginning on the next page. Inspiring that admonition is a masterly grasp of economic and industrial conditions by a practical engineer whose achievements have merited and received world-wide acclaim.

. . . In the conviction that the President has thus pointed out the only way to renewed and continuing prosperity for our industrial establishments, suggestions have been given in the article on the general procedure to be followed in putting our plants in order. Its objective is to stimulate the process of translating counsel into action.

. . . If anyone is so misguided as to think that industrial competition will decrease hereafter, the signs of the times must be examined anew. In countless instances not merely local, but world markets are at stake, and in the struggle to seize them no mercy will be shown to the halt and weak—the plants with worn-out equipment and obsolete methods.

. . . There *must* be uninterrupted production at low cost. To this end the most thorough and comprehensive maintenance program ever launched has been set in action by President Hoover.

. . . The maintenance engineer is the man of the hour! To him has been entrusted a task that is a challenge and an inspiration. His responsibility will be discharged only to the extent to which the maintenance program is carried out within his plant.

Make this program effective in your plant!

The Maintenance Engineer Is the Man of the Hour!

Here is the work he will do to

Prepare Now *for* Cheaper Production

THE greatest tool which our economic system affords for the establishment of stability is the construction and maintenance work, the improvement and betterment, and general clean-up of plants in preparation for cheaper production and the increased demand of the future.—*President Hoover in his message to the United States Chamber of Commerce, December 5.*

THUS is outlined, in masterly fashion, a policy that can be followed during the next several months to the lasting advantage of all industry. To this policy *Industrial Engineering* has always subscribed.

In effect, and in fact, this policy is an endorsement of maintenance in the broad sense that industry has adopted. This true maintenance calls for a thorough study of the entire plant, covering all of the electrical and mechanical systems, buildings, and services, as well as the production equipment. Its purpose is to determine the exact status of the plant—gaging it by modern standards—and to locate and remedy weak spots; all for the purpose of securing maximum, uninterrupted production at the lowest possible cost.

In carrying out the details of a thorough maintenance and rehabilitation program certain major objectives must be set up. They are:

1. **Securing the greatest measure of adaptability of plant and equipment to the service requirements.**
2. **Reduction of power losses, by increasing efficiency of equipment.**
3. **Increased reliability of equipment and safety to both personnel and equipment.**
4. **Increased flexibility in meeting sudden changes in conditions.**
5. **Increased productivity from personnel resulting from improved plant conditions.**

These objectives will, in general, be attained by:

1. **Replacing obsolete or unsuitable equipment by new equipment of suitable design.**
2. **Shifting older, but still good, equipment to places where the duties are less exacting or important.**
3. **Putting equipment that is to be retained in first-class condition by a thorough overhauling.**
4. **Organizing the personnel for plant engineering and maintenance along effective lines, with responsibilities clearly defined.**
5. **Giving full measure of cooperation to production department in acquisition, maintenance, and disposition of production equipment.**

In view of the wide divergence in the conditions and requirements existing in different industries, as well as in different plants in the same industry, any discussion of the problems involved in carrying out such a program necessarily must be limited to the application of general principles. Nevertheless, the following suggestions will be helpful in throwing into relief the points that must be given consideration.

Electrical Distribution System

Beginning this constructive survey with the electrical distribution system, study the location of load centers and the general method of distributing power, to determine whether or not it is being done most efficiently from every standpoint. Bear in mind:

(a) Flexibility requirements to permit of rearrangement of machines.
(b) Provisions for sectionalizing feeders so that trouble in one part of the system will not shut down the entire plant.
(c) Necessity for protective devices to be able to disrupt safely the maximum short-circuit current that could be developed with the existing power supply.
(d) Provisions for departmental metering, so that more accurate cost records can be kept and power losses checked closely.

Check the capacity of all feeders and transforming equipment, to prevent excessive voltage drop and insure good regulation.

Check the power factor to determine the need for, and possible savings to be made by, the installation of corrective devices.

Study the plant load curves for the possibility of reducing peak loads and lowering demand charges.

Investigate the substation and distribution system to determine whether, and how, future extensions can be made.

Inspect all elements of substation and distribution systems in detail to ascertain present condition and need for repairs to, or replacement of, parts or entire devices.

Electrical Elements of Power Drives

Proceeding then to an inspection of the electrical elements of power drives, consider *motors:*

Compare with the latest types available from the standpoint of efficiency, power factor (in the case of a.c. motors), suitability for load conditions (starting and pull-out torques, speed regulation and range), protection needed against acid fumes, moisture, dust.

Check performance records to determine frequency and nature and extent of repairs. Estimate probable cost of repairs for the next year or so to determine whether a saving can be made by replacing with a new motor.

Check the loads on all motors, to insure operation at maximum efficiency, and to prevent under- and over-loading.

Consider the advisability of shifting motors around to equalize loads, designating the best motors on the most important drives.

Look into the possibility of carrying part of the load by synchronous motors, to improve power factor.

Determine the condition of bearings, windings (by means of insulation resistance measurements), and other parts, and overhaul and paint the windings of all motors that are to be kept in service.

Controls

Consider next *controls.*

Study all control equipment from the standpoint of what the latest types offer in reliability, protection required under service conditions, degree of skill required for operation, maintenance attention needed, suitability in the event that duty cycles or operating conditions must be changed to meet new production requirements, and safety to operator and machine.

Consider the advantages of magnetic control versus manually-operated types.

Look into the advisability of using the older controls on the less important drives only, with new equipment on major services.

Make a detailed inspection of all controls to be retained, to determine condition and need for repairs or replacement of parts.

Mechanical Power Transmission Equipment

The survey of the mechanical power transmission systems may well have as one of its prime objectives the determination of whether group or individual drive, or some combination of the two, will most economically meet the operating conditions and requirements. Many factors must be given due consideration in any such study. Among these are:

(a) Character of driven machines, power requirements, and nature of load (steady, intermittent, shock).
(b) Layout of plant and arrangement of machines.
(c) Necessity for providing flexibility of power service, so that some machines or groups may be operated while others are idle.
(d) Capital investment required to equip plant with (a) group drive and (b) individual drive.
(e) Power required to operate under each system (compare total power, power factor, maximum demand).
(f) Probable yearly cost of routine maintenance, including replacement of parts, for each system, considering repair facilities and class and wage scale of maintenance and repairmen needed.
(g) Facility with which changes in speed, arrangement of machines, and nature of material handled, may be made.
(h) Incidental advantages and disadvantages of each system, such as interference with natural or artificial illumination, safety to personnel and equipment, general appearance of shop.

With these major considerations out of the way, the survey should be extended to include the drive connections to individual machines. This study should seek to determine:

(a) Best type of connection (through belt, coupling, chain, reducer, other device).
(b) Influence of atmospheric conditions.
(c) Whether the unit selected is best adapted to the requirements.
(d) Ease of making changes in speed, or providing for variable-speed operation, if necessary.
(e) Whether transmission equipment and drive connection are properly loaded and operated.
(f) Possible savings in floor space and other advantages to be gained by use of short-center drives.
(g) Advantages of anti-friction bearings in transmission equipment and driven machines in reducing static and running friction, facility of sealing against entrance of dust or liquids, reduction in lubrication and maintenance attention.
(h) Present condition of all elements, so that adjustments, repairs, or replacements may be made.

Materials-Handling Equipment

The first step in any program to reduce materials-handling costs must of necessity involve a thorough study and analysis of all handling operations and problems from the time the raw materials are received until the finished product is sent on its way to the purchaser. Quantities of materials handled, unit weights, character of materials, special precautions necessary, production requirements as to rapidity or continuity of movement, distance to be moved, and all other factors that have a bearing on the problem must be determined.

With these data in hand, the way is prepared for further studies looking toward the selection of appropriate types of equipment to take care of the various handling jobs. During this study bear in mind:

(a) Possible changes in character or amount of materials to be handled.
(b) Savings possible after deducting cost of power to operate, and all fixed and operating charges.
(c) Features of plant layout that will interfere with the installation of an ideal system, and may be expensive to overcome.
(d) Auxiliary services necessary for effective functioning of the equipment, such as despatching system, battery-charging outfits, provisions for loading and unloading, safety devices.

If a plant is already using some up-to-date materials-handling equipment the problem will be less involved that is indicated above. Nevertheless it will be well to make such studies as are necessary to give a clear picture, based on facts, of the problems to be met, and the present manner of solution.

The following questions may stimulate suggestions for further reductions in handling costs:

(a) Will it be possible to appreciably reduce materials inventory by the addition of materials handling equipment?
(b) Do men on assembly operations wait for work at times—or do they go after parts?
(c) Are two or more men required to move any load by hand?
(d) Does a man lift more than 100 pounds?
(e) Do men lift loads from floor to truck or from truck to floor?
(f) Are men used in racking and stacking, to the exclusion of machinery?
(g) Do men lift heavy parts into and out of machines?
(h) Could the quality of product be improved as to certain operations (e.g., spray painting, enameling, washing) if handling equipment were used?

In regard to equipment already installed

(a) Is the power consumption as low as can be expected?
(b) Or would the adoption of anti-friction bearings be justified (in relation to the probable life of the equipment)?
(c) Is the lubrication system such as to make for low power consumption and maintenance cost?
(d) Is re-routing advisable?
(e) Should lifts be reduced or increased? Sharp turns eliminated? Re-tracking done away with?
(f) Does the equipment give lowest unit cost?

Production Equipment

Many of the suggestions given heretofore apply to the maintenance of production equipment. A broad program should include inspection for determining condition of foundations, whether machines are level or not, condition of bearings, slides, feed screws, cams, gears, packings, lubricating devices, and the like. The inspection reports will be of invaluable assistance to the production department in determining what equipment to replace. They will, also, serve to point out the repair work that is to be done.

Lighting

If the light is poor, production efficiency cannot be at its maximum. The only remedy for an obsolete lighting system is the replacement of the antiquated and unsuitable equipment by correct reflectors and lamps, properly located—in other words, install scientifically planned lighting of sufficient intensity.

A planned lighting system properly involves a light survey of the plant with measurements of the intensities of both natural and artificial light followed by a check-up of those intensities against intensities commonly accepted as adequate or which at least conformed to good practice, for the different areas involved. An illuminating engineer, in laying out a new system or revamping an old one, will of course pay much attention to the location of switches, the arrangement of control circuits from the standpoint of flexibility and efficient utilization, and the necessity for providing facilities for easy inspection and cleaning of fixtures.

Bear in mind that it is good economy to install feeders of sufficient capacity to provide for large increases in the line of illumination if desired later on.

For a system that is basically correct, but run down, there are several principal causes of depreciation: Dirty reflectors and lamps; darkened walls and ceilings; age of lamps; empty sockets; unobserved burnouts; improperly-made replacements; conductors of capacity insufficient to prevent excessive voltage drop; lamps improperly located because of changed floor layouts.

Painting

Painting of industrial buildings and equipment serves two main purposes: First, to protect against rapid decay and, second, to decorate or improve the appearance. With interiors, painting plays a very important part in supplementing the lighting system by reflecting a large part of the light that strikes walls, ceilings, and other surfaces—assuming, of course, that these surfaces have been treated with a suitable medium.

In the interest of preventing costly repairs by preserving woodwork, iron and other materials from decay, all building exteriors should be well painted whenever a careful inspection shows this to be necessary.

In the case of interiors, answers to the following questions will help to indicate whether or not painting is needed, and to suggest suitable characteristics for the paint that is to be applied:

(a) Do ceilings and upper side walls reflect not less than 65 per cent of the light striking them?
(b) Lower wall areas from 30 to 50 per cent?

(c) Machinery, benches, not over 25 per cent?
(d) Are intricate machines painted white where it is advisable to prevent objectionable shadows?

Buildings

Construction of new buildings, either to furnish additional capacity or to replace obsolete structures, should be considered at this time. In the case of existing buildings both major and minor changes, as well as the obvious upkeep operations, should be included in the rehabilitation program.

These changes may include enlarging doorways and passageways to permit the better use of trucks; building new or enlarging existing elevator shafts; removing walls and partitions; building additions to facilitate manufacturing operations, simplify materials handling problems, and improve working conditions. Look particularly to the conditions of floors, and repair and replace any that are in such poor shape as to interfere with trucking or other operations, or that present injury hazard.

Air Conditioning

Some manufacturing operations that involve processing of materials which are affected by atmospheric conditions have virtually been revolutionized during the past few years by the development of practical methods and equipment for humidifying or dehumidifying air, cooling or heating it, filtering it, and in other ways treating it to produce the characteristics desired.

In any plant whose processes or products are adversely affected by atmospheric conditions, a very careful investigation should be made to determine whether production delays and spoilage of materials can be eliminated, or the quality of the product improved, by air-conditioning equipment.

Of prime importance, also, is the problem of providing adequate heating and ventilating facilities for shops and workrooms. It is futile to expect workers to produce at their maximum efficiency in cold and drafty, or hot and poorly-ventilated rooms. Furthermore, the effect of such conditions in causing high absentee rates from sickness is highly important.

Needed improvements and possibilities of cost reduction, as well as means by which they can be made, may come to light upon a searching examination of the plant heating and ventilating systems. Among the points to be determined, or kept in mind are:

(a) Heating requirements, as affected by plant layout and nature of work.
(b) Best method of heating under existing conditions (exhaust or live steam, hot water, hot air, etc.).
(c) Is present system laid out and operated to secure highest efficiency?
(d) Does it provide sufficient uniformity of temperature throughout working areas?
(e) Is automatic control of temperature employed to prevent extremes?
(f) Are there any "cold spots" wherein equipment such as unit heaters could be used as auxiliaries?
(g) How many changes of air are there per hour?
(h) Does the method of ventilation cause objectionable drafts?
(i) Is control of ventilation automatic, or is it left to the whims of workers?

Closely allied is the matter of adequate provision for removing dust, fumes, and other harmful byproducts before they contaminate the air of workplaces.

Other Improvements

In a thorough program of plant betterment the most careful attention should be given to bringing all equipment up-to-date so far as *lubrication* is concerned. Analysis of existing lubricating systems will show the idle time of equipment caused by lubricating during operating time or during repair. What is the desirable frequency of attention in operating the system? Shall lubricating be done from the floor, or from ladders or scaffolds? Must the system allow lubrication while the machinery is in operation? Must there be selected a system from which surplus lubricant cannot escape to injure product in process?

Communication within the plant, if properly planned, will be an important part of betterment in any but the smallest plants. Connection of departments by telephones, call systems, production control systems, and alarms falls into this category.

It is obvious that the complete system for *protection against fire* should be inspected and that there should be made up any lack of equipment such as chemical extinguishers; pails and hose; fire doors and walls; sprinklers; fire pumps.

Organization for Maintenance

Certainly no plant can hope to reach and maintain a high mark in manufacturing efficiency without a well organized force of trained men who are capable of handling promptly and properly any likely emergency as well as the routine work of inspection and repair of equipment and buildings.

Representative plants have so arranged their work for plant engineering, or for maintenance in the broad sense, that a composite of their organizations shows the work to be divided into three groups:

Electrical Activities
Mechanical Activities
Building Activities

The heads of the three groups report to a chief who directs the plant engineering or maintenance activities as a whole, and who is the link between those activities and the factory management.

Ordinarily included among the plant electrical activities are: Power supply services; Electrical maintenance; Lighting; Maintenance welding; Electric repair shop; Alarm, signal and communication services.

Mechanical Maintenance includes: Factory layout; Mechanical repair and repair shop; Lubrication mechanical equipment; Plumbing; Sheet metal shop; Safety.

Activities in connection with buildings include: Minor construction and upkeep; Heating and ventilating; Painting; Carpentry; Masonry; Upkeep yards and grounds; Watch and janitor services.

In a comprehensive maintenance program the existence of an experienced organization functioning along the lines indicated is of incalculable advantage. Lacking such an organization, the betterment and rehabilitation activities of the next few months may well include its establishment. In putting the organization together now there will be the advantage of giving it immediately a job that will involve all of the ramifications for which it is intended.

Plant MAINTENANCE

Under Divided Authority

By C. A. ZIEBARTH
General Superintendent,
Bell & Howell Company, Chicago, Ill.

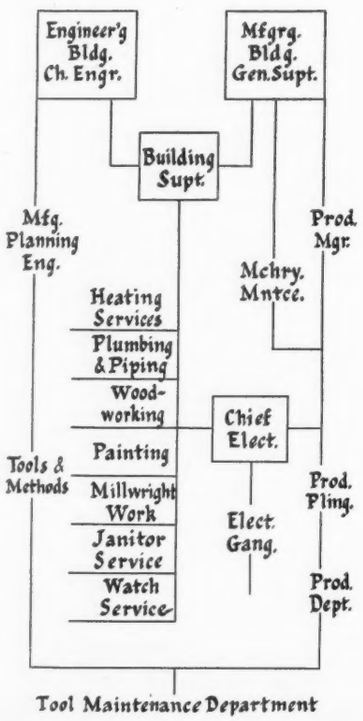
DIVIDED responsibility, insofar as maintenance activities in industry are concerned, is not unusual. Previous articles in *Industrial Engineering** have dealt with organizations having single responsibility, but at the plant of Bell and Howell, Chicago, Ill., manufacturers of motion picture cameras, responsibility for maintenance activities is divided.

Until some time ago all plant maintenance functions came under the supervision of the general superintendent. They were building maintenance, machine repair, and electrical maintenance. Each division functioned as a separate unit under the control of a leader, who had the title of superintendent or, in the case of the electrical department, electrical engineer.

With the acquisition of a second building to satisfy the need for additional manufacturing space, the control scheme for plant maintenance was, of necessity, somewhat modified in accordance with the chart shown on this page. The various departments organized to carry on plant engineering activities retained their identities as to personnel, but their fields of activity were enlarged, and supervision was transferred from the production department.

It is evident from the chart that no one is vested with the title of plant engineer yet it is quite easy to discern that the responsibilities of such an executive are in the hands of the general superintendent to a certain extent. Divided responsibility in this instance is due to the existence of separate plants which must be brought into the picture before breaking down the duties of the different departments engaged in plant maintenance.

Some distance from the main plant is the new building, a two-story structure 130x150 ft., which is devoted to engineering research under the direction of the chief engineer, who assumes responsibility for work of every character pertaining to this building. The original building is wholly devoted to manufacturing under the responsibility of the general superintendent. Between these two individuals the executive authority for every activity rests.



General plan of the plant engineering groups.

As stated previously, the plant engineering is divided among four groups: building maintenance, which includes plant services; machinery maintenance; tool maintenance; and electrical maintenance. A building superintendent is in charge of the building maintenance group, a machinery maintenance superintendent supervises all machinery maintenance, tool maintenance foremen supervise tool repairs and replacement, and the electrical engineer as chief electrician directs the efforts of the electrical group.

Of these four divisions only one is actually common to both plants and the head thereof reports to two executives. The building superintendent is responsible for work done by his group in the engineering building to the chief engineer, and likewise to the general superintendent for work done in the manufacturing plant. The machinery maintenance superintendent reports directly to the general superintendent and to the production manager. The electrical engineer, however, is a member of the engineering department, but, in addition, this individual is in effect chief electrician and as such for a variety of reasons refers the results of his maintenance activities to the general superintendent and to the production manager (in the latter case particularly, when electrical services are required in the production department).

Tool maintenance, or the repair, replacement, or alteration of tools, is also handled through divided responsibility. The maintenance tool room is located in the original building, the general tool room in the new building directly under the responsibility of the chief engineer. The

*"How We Are Organized for Maintenance and Plant Housekeeping," W. G. Ross, Chief Engineer, The United States Aluminum Company, New Kensington, Pa., April, 1929; "Organization for Plant Operation and Maintenance" (organization of E. J. Brach & Sons, Chicago), July, 1929; and "National Cash Register Organization for Plant Engineering," E. D. Smith, Maintenance Engineer, September, 1929.

Manufacturing order used on jobs requiring executive authority.

FORM NO. 115-A

MANUFACTURING ORDER—Original

SHOP SHEET

Mfg. Order No. _____

Date _____

NOTICE This sheet contains full details concerning the order to which it refers. If not understood, return to the office at once. Fill in requisition numbers for materials or parts used soon as issued and check over when order is completed before sending to Accounting Department.

Article or Description of Work	Requisition Numbers	Design No. _____ Part or Sub. Ass. No. _____
		Date Wanted:
		Disposition:

CK.		DATE	INITIAL
	Start		
	Finish		
	Received in Stock		
	Office Extension		
	Stores Entry		
	Filed		
	UNIT PRICE		

ved _____ Approved _____

Obverse (Miscellaneous Job Cost), reverse (Miscellaneous Job Time) Card used in conjunction with the Manufacturing Order.

Form No. 21. J 5-7-29

MISCELLANEOUS JOB COST CARD

(For use of J. O. Tool and Miscellaneous General Orders)

DESCRIPTION OF JOB _____ MFG. ORDER No. _____

CHARGE TO _____

A/C No. _____ DATE ORDERED _____ 19____

MATERIAL

MONTH	REQ'N No.	DESCRIPTION	No. of Lbs. or Pieces	AMOUNT

MISCELLANEOUS JOB TIME

MO.	DAY	DEPT	CHECK NO.	RATE	HRS	100TH HRS	WEEKLY TOTAL	MONTHLY TOTAL	MO.	DAY	DEPT	CHECK NO.	RATE	HRS.	100TH HRS	WEEKLY TOTAL	MONTHLY TOTAL

TOTAL

SUMMARY OF COSTS

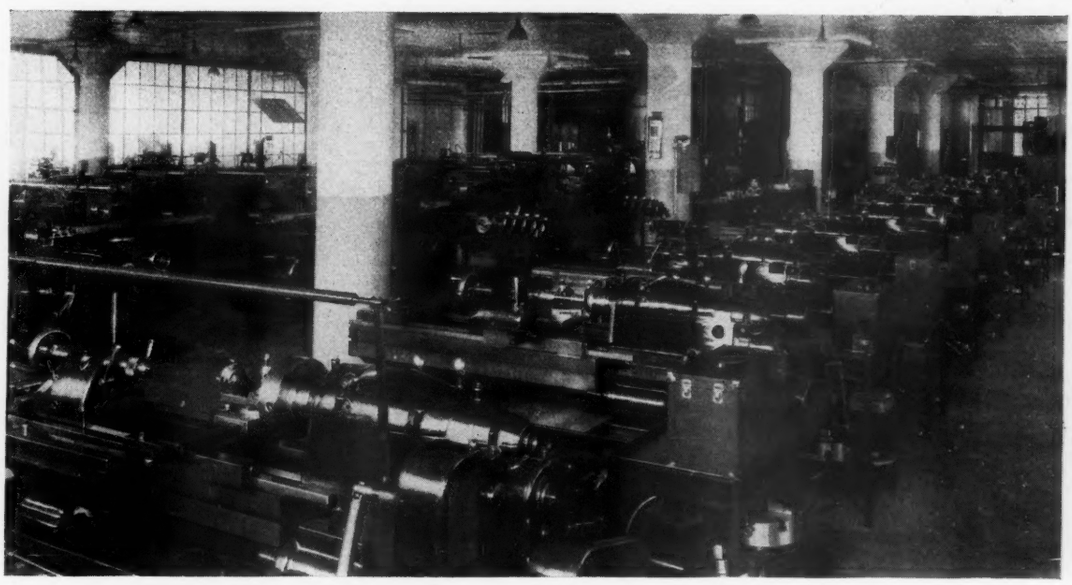
DATE COMPLETED		LABOR (See Ovw)			
EXTENSIONS		MFG. OVERHEAD	%		
MONTH ABSTRACTED		PER TOOLS "	%		
COST ANALYSIS		MATERIAL			
TOOL CARD RECORD		U. M. S. OVERHEAD	%		
LABOR ANALYSIS		TOTAL COST			
APPROVED					

foreman of the maintenance tool room is responsible to both the chief engineer and the general superintendent, reporting, however, through the manufacturing planning engineer, as assistant to the chief engineer, on questions of design or construction, and to the production manager as to sequence or schedule of jobs to be given preference.

That group supervised by the building superintendent is composed of millwrights, painters, carpenters, plumbers and pipe fitters, janitors and watchmen, who in turn are headed by a chief or foreman. Of the other plant services the department is also responsible for plant heating. The electrical and the mechanical maintenance groups are chiefly composed of picked employees who have served their time in the production department after finishing apprentice school, which is a company project, under the supervision of the machinery maintenance superintendent.

Approximately 35 men comprise the groups thus engaged in maintenance work for a plant with two buildings having about 115,000 sq. ft. of floor space, from 1,000 to 1,100 employees, and a connected load from 300 motors of from 700 to 800 horsepower.

Under the organized plan as indicated by the chart the breakdown of duties of the four groups is almost self evident. The building superintendent takes care of all work incident to both buildings except production equipment, that is, elevators, heating and ventilating equipment, roofs, lighting, decorating, piping, cleaning, and protection such as fire and watch service. The chief elec-



In the engineering building, the entire management of which is the responsibility of the chief engineer.

The Tool Complaint Form upon which is outlined the nature of the work to be done. An original and three copies in color are made and distributed to the proper authorities.

Requisition for necessary repairs and replacements are made on a form like this. An original and two copies in color are used and distributed to the proper authorities.

TOOL COMPLAINT DATE

DESIGN NO	PART NO	NO. AND OPERATION	PREFIX	SERIAL	LETTER	NO.

TO DEPT.	DATE REC'D	BY		DATE REC'D	BY	DEPT.	DATE REC'D	BY	DEPT.	DATE REC'D	BY
34			45								

DESCRIPTION OF TROUBLE

Form 129 No. 63658

BELL & HOWELL CO.

REQUISITION FOR PRODUCTION ORDER

ORDER DEPARTMENT DATE

Please issue manufacturing order for the following: ORDER No. Assigned to this work

QUANTITY	ARTICLE OR DESCRIPTION OF WORK

NOTE: Always indicate design number, for Repairs, Tools, Parts or Assemblies.

DATE WANTED

PROPERTY OF CUST. YES NO

IN REPORT NO.

APPROVED:

DISPOSITION: CHARGE

ACCOUNT NO. ABSORB

SALES ORD. NO.

CUST. ORD. NO.

REPAIR CARD ATTACHED

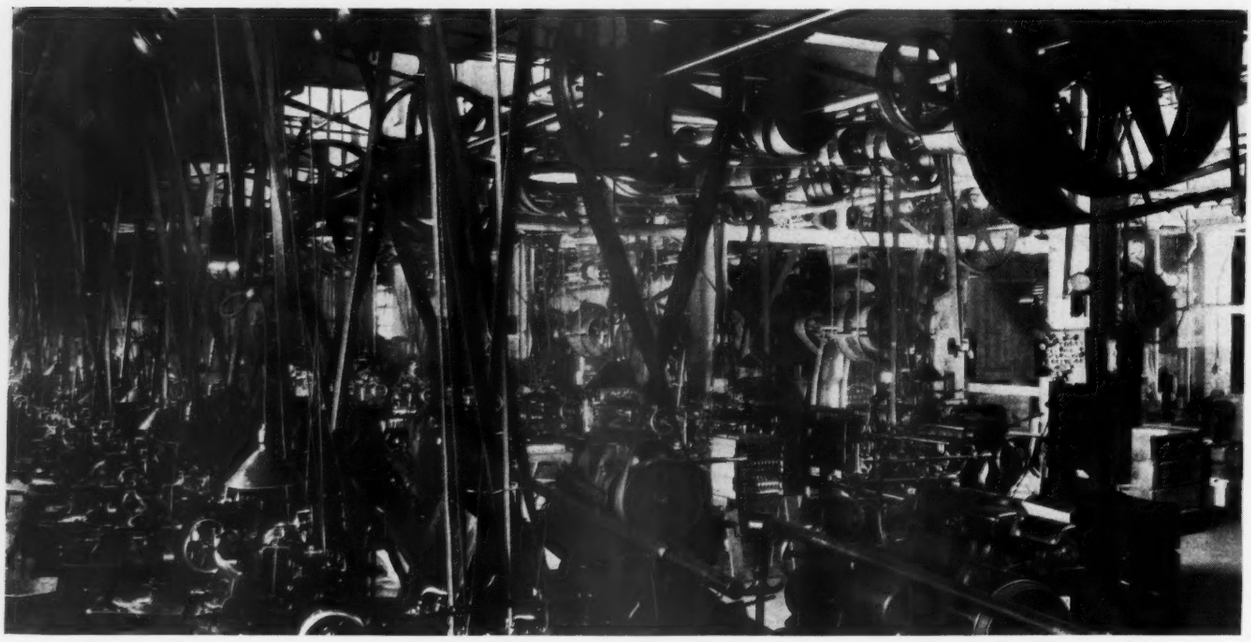
SUBMITTED BY

E. 5-14-29

trician takes care of all things electrical, such as power distribution, motive power, illumination, and intercommunication. The machinery maintenance superintendent handles the principal mechanical functions as related to plant machinery. In this respect the members of this group may be engaged in making minor adjustments to production machinery or in the rebuilding of this equipment to conform to new designs developed by the engineering department. The tool maintenance group, however, does tool work only.

Considerable leeway is permitted the various groups in the conduct of their activities, which, of course, must be in the right direction. For instance, maintenance work is calculated on a time basis except in unusual circumstances. A period of two man-hours is allowed for any job without official sanction, that is, an approved order; however, if a job is started and complications develop which indicate that the time allowance will exceed five man-hours, all work must stop immediately or be postponed pending authority from the general superintendent for its completion.

An approved estimate for new construction or the revamping of existing equipment constitutes authority for the requisition of mate-



A small section of the manufacturing plant in which electricians are not used on mechanical maintenance.

rial in accordance with the Manufacturing Order, a copy of which in blank is reproduced herewith. This form is used as an expense order for a certain period, a week, a month, and so on; others, however, close annually. An original and two copies are made which, when completed, constitute a complete history of the job.

Manufacturing Orders for tool maintenance work are the same as issued to the building superintendent. For minor corrections, repairs or alterations, the tool room is allowed to charge time up to five hours against an Expense Order. The nature of the work is outlined on the Tool Complaint, which is issued by the foreman having tool trouble, and which is approved by the production manager. For additional or duplicate tools, an estimate is necessary covering the cost of construction from the manufacturing planning engineer with an estimate of earning value from the production manager before submitting to the general superintendent for approval.

In the accounting or cost department all charges are picked up as entered against the job. Miscellaneous Job Cost Cards, reverse and obverse sides shown in an accompanying illustration, carry the necessary information on material and labor to enable the cost department to prepare an itemized cost statement which is submitted for scrutiny to the general superintendent or other executive originating and authorizing the work to be done. Some jobs are authorized on blanket orders for the period over which the job runs, as a result of an established practice. Machinery moving, for instance, calls for a blanket order which remains open for a period of a year.

Ordinary trouble that might be caused by ordinary wear and tear, and brought to the attention of the various production foremen, is handled quite simply. In all such cases the production manager is acquainted with the details and, since the equipment comes under his supervision, he causes requisitions to be made for the necessary repairs or replacement of material. These Requisitions (Requisition for Production Order), however, are referred to the general superintendent for approval. Other cases are handled similarly.

Even though adjustments are advisable from time to time, their character is such as not to interfere with the organized plan which, though divided in responsibility, covers the plant engineering activities as a unit.

"*Substituting Instructions for Reprimands*"—Discussion

THE editorial, on page 624 of the December issue of *Industrial Engineering,* entitled "Substituting Instructions for Reprimands," is worth serious consideration. Some years ago the writer was connected with a plant in which practically the same suggestions as mentioned in the article were followed, and the results obtained therefrom were highly satisfactory from every point of view. Every new employee in the electrical maintenance department was handed a loose-leaf binder containing some general data, such as a description of the plant, its product, output, number of employees, and the relative size of the plant with respect to others in the same field. The idea was to impress the newcomer with the importance of the plant and create a spirit of pride in being connected with it.

This was followed by a complete description of the electrical equipment, both standard and special, including data as to the sizes of the various units, their location, and purpose.

Wiring diagrams of unusual equipment, such as automatic motor starters with a number of control stations located at different points, elevators, dynamometers, special machine tools, etc., were furnished. Duplicate diagrams, enlarged and mounted on heavy cardboard coated with clear shellac for protection, were placed near some of the machines. In all cases where necessary, the standard wiring diagram accompanying a machine or motor, as received from the manufacturer, was redrawn to conform exactly to the way in which the equipment happened to be applied in this particular plant. Attention was called to special tool equipment available for assembling or disassembling machines, such as bearing shell and pulley removers, arrangements to facilitate quick changing of machines in case of breakdown, etc. Every attempt was made to provide for every eventuality that past experience had taught might occur or could be prevented by proper measures. What were known as "emergency kits," consisting of sheet metal boxes of obsolete and discarded auto-starters, were mounted on posts at convenient points about the plant, and these contained spare links for refillable fuses, wrenches, oil can, small pinch bar, and so on. They were kept locked and were accessible only to the electrical force. Judgment must be used in the placing and equipping of such "kits," as the expense involved may easily exceed the saving effected through their use. Whether such an arrangement would prove a good investment in other plants would have to be determined in each particular case.

Changes or revisions were made in these instructions from time to time, or as the addition of new equipment or changes in the old made it necessary. Efforts were made to provide for every contingency. Routine matters were thoroughly covered, so that little cause existed for misunderstandings or not knowing what to do in an emergency. A large blackboard set up in the electrical shop was always available for threshing out any obscure points or complicated wiring.

A new man, before assuming his duties, was always taken in tow by an older employee and shown over the plant, and the references contained in the book were pointed out to him. The cost of these books was comparatively small, the drawings were all blueprinted, the instructions being typewritten and then also blueprinted. A nominal charge was made for the book, which was refunded when the book was returned by an employee when he left the company. The manner in which the employee performed his duties soon furnished a check on whether the instructions were being read or not.

Whether another plant would be justified in adopting these same plans wholly or in part, would depend on individual circumstances and the size of the plant. They are recalled here with the hope that they may furnish ideas and suggestions to the plant engineer which will be applicable to his own plant. In the case of the plant where the above ideas were put into practice, the management felt that the results obtained were well worth the effort.

Cleveland, Ohio. P. JUSTUS.

"INTERMITTENT SERVICE" Requires the RIGHT MOTOR

Fig. 1—Crane trolley equipped with series-wound hoist motor and floor-mounted solenoid brake, series-wound trolley motor, hoist limit switch and jackshaft brake.

By H. H. VERNON
Industrial Engineering Department
General Electric Company
Schenectady, N. Y.

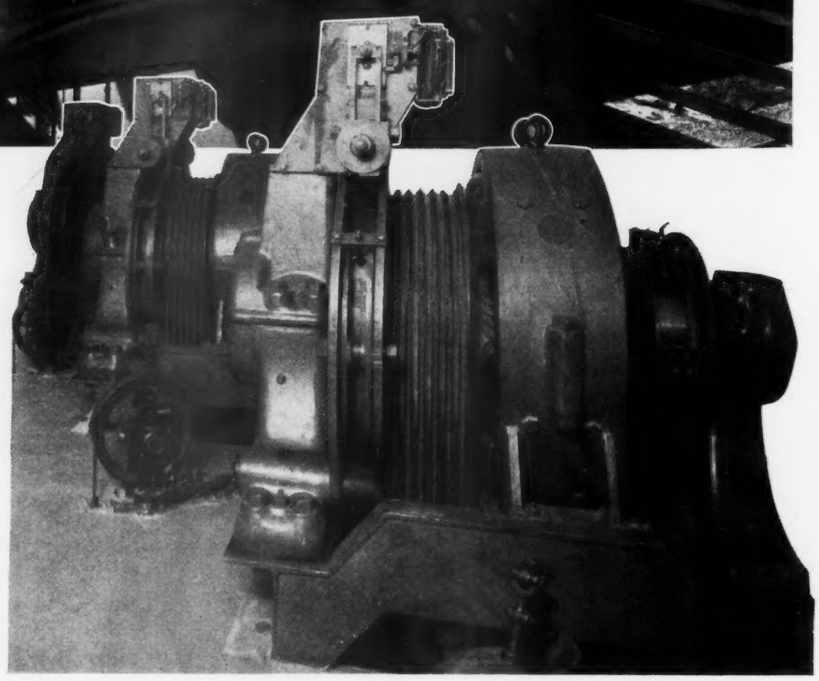


Fig. 2—Direct-current, gearless-traction elevator equipments.

SINCE cranes and elevators are not standardized as to size and kind several different types of motors are used to operate them successfully. These motors include the series-, shunt- and compound-wound d.c. types and the single and two-speed squirrel-cage and single-speed slipring or polar-wound rotor a.c. types. The following discussion deals with these different types of motors and their characteristics in relation to the requirements for cranes and elevators in general.

Direct-Current Crane Motors

The series-wound d.c. motor is most commonly applied on cranes taking d.c. service and it is usually rated on an intermittent basis such as 15, 30 or 60 minutes. A typical installation is shown in Fig. 1. It is a 20-ton yard crane equipped with a series-wound hoist motor and floor-mounted solenoid brake, series-wound trolley motor, hoist limit switch and jackshaft brake.

There are several reasons why a series-wound motor should be used, some of which are: More torque per ampere or more work per kilowatt input; high speeds with light loads or more material handled in a given time; very large overload torque or ability to lift loads above the rated capacity of the crane; torque not affected by voltage drop. The torque of a series-wound d.c. motor is directly proportional to the current in the armature and series field and is not a function of the speed, therefore, as long as there is sufficient voltage across the motor terminals to produce the current and torque required to lift the load on the hook the load will be lifted. The speed, however, will depend on the voltage impressed on the motor. If the voltage is high the speed will be of one value and if it is low the speed will be low compared to the high-voltage speed.

Because of its speed torque characteristic, low speeds, high speeds and dynamic braking may be obtained by the use of standard control devices. Furthermore, it must be loaded sufficiently to keep the speed down to a safe value and this is done on the hoist motion by friction or dynamic braking. Sufficient friction

is produced by the gears, bearings, etc., in the hoisting direction but in the lowering direction when the load tends to overhaul or drive the motor inefficient worm gearing or an automatic mechanical load brake must furnish the load unless dynamic braking is used.

The automatic mechanical load brake is usually located on the first jack shaft from the motor and is a device that runs free in one direction but binds and produces friction in the other direction. Dynamic braking is produced when the motor is so connected through control devices that it acts as a generator and generates power that is dissipated as heat in a resistor.

Series Motors

Series motors are used for the trolley and bridge motions of a crane where the speed is not greatly affected by the load on the hook because it is a small part of the total weight.

A safety feature of a series-wound hoist motor with standard reversing control is that if either the armature or series field circuit is broken the brake is applied and the motor is disconnected from the power supply.

Shunt and compound-wound motors are very seldom used on cranes for several reasons. We will consider the shunt-wound motor first. Because the field current is small the field leads are small and easily broken or the collector shoe might leave the feed wire, therefore, there is a possibility of having power on the armature without a field which might damage the motor. The speed is practically constant from no load to full load, therefore, the hook speed is almost constant.

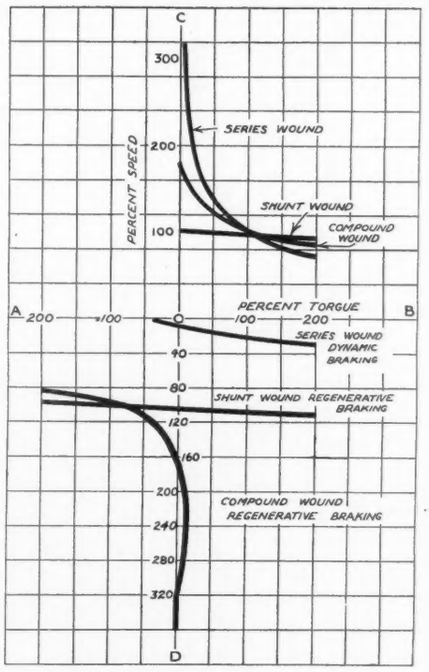


Fig. 4—Torque speed curves of series, shunt and compound-wound motors. Above the axis AB the curves are for motors and below the axis the curves are for generators.

The compound-wound motor has the same disadvantage with its shunt field as the shunt-wound motor and it cannot be used for regenerative braking without complicated control. When the change from motoring or positive torque to regenerative braking or negative torque takes place the armature and series field current reverses and unless the shunt field is reversed the shunt and series field would have currents flowing in opposite directions. This means that to obtain regenerative braking with a compound-wound motor the shunt or series field connections must be reversed at the instant the motor current passes through zero, which would complicate the control.

Direct-Current Elevator Motors

In contrast to the series-wound motors for cranes are the shunt and compound-wound motors for elevators. Fig. 2 shows an installation of three gearless, variable-voltage car switch controlled equipments, whereas Fig. 3 shows their accompanying variable-voltage m.g. sets. Shunt-wound motors are most commonly used for elevators and the reason is that the motor may act as a motor or a generator in hoisting or lowering the elevator car. The change from motor action to generator action or *vice versa* is entirely automatic and takes place within the motor. When the elevator starts from the ground floor it may be loaded to capacity and the driving motor would act as a motor but at the first stop all of the load might be removed and as soon as the elevator is accelerated to full speed in the same direction the driving motor will act as a generator because the counterweight, being heavier than the elevator cage, will drive the motor and it will change from motor action to generator action.

In this way it acts as a brake

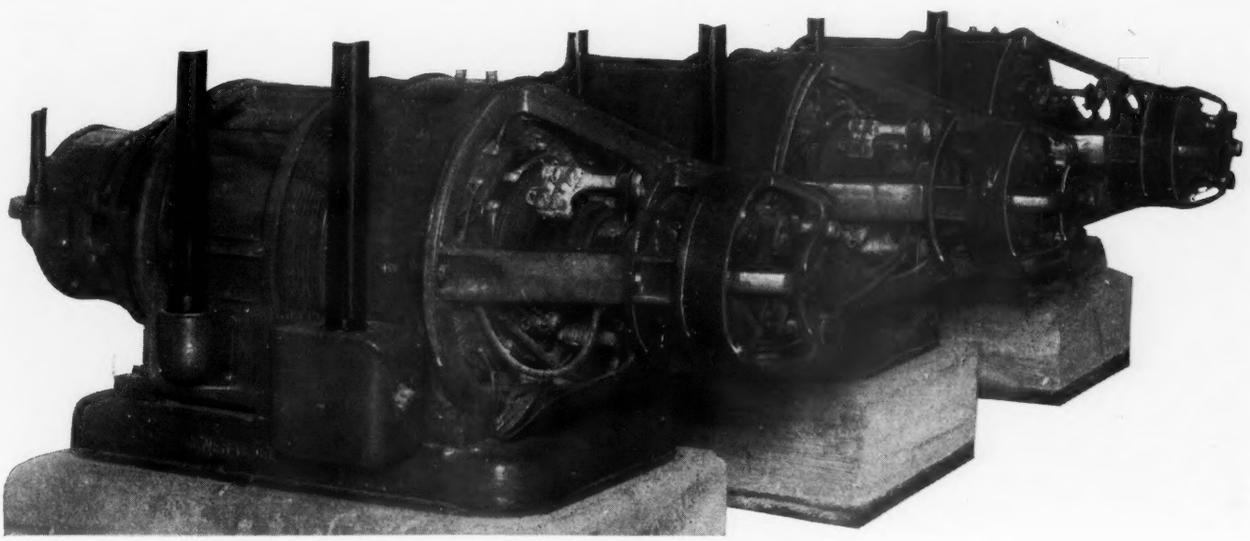
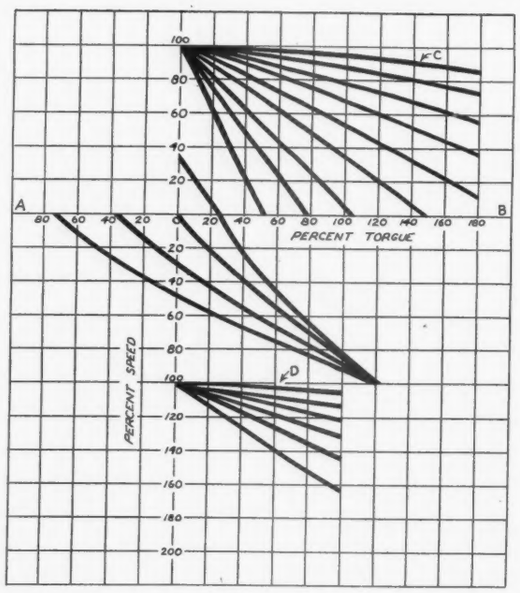


Fig. 3—Variable-voltage m.g. sets for the gearless-traction elevator drives shown in another view.

Fig. 6—Torque speed curves of a wound-rotor motor equipped with solenoid load brake. The curves above AB are for hoisting, those below are for lowering. All curves except C and D can be modified somewhat by changing the resistance in the rotor circuit.



and prevents the counterweight from raising the elevator at too high a speed. Because the speed of a shunt-wound motor is almost constant the speed when running as a generator is only slightly higher than when running as a motor regardless of the load. The torque speed curves shown in Fig. 4 are used to emphasize this point.

When compound-wound motors are used for elevators the series-wound portion of the field is short circuited by the control the same as the accelerating resistor is short circuited; in fact the series portion of the field is considered a part of the starting resistor and is short circuited either as the first block of resistance or the last.

The chief reason the compound motor is used is that it provides more torque per ampere than the shunt-wound motor and the result is smoother acceleration of the elevator. The series portion of the field must be short circuited or cut out of the motor circuit because when the motor changes from motor action to generator action the shunt and series fields would be connected differently, that is, the current in one field is in one direction and the current in the other field is in the opposite direction, therefore, they neutralize each other and the result is a weak field and, a high speed.

Alternating-Current Crane Motors

Alternating-current power is becoming almost universal and for this reason at least 75 per cent of the cranes that have been installed in the past few years have been motorized with induction motors. Induction motors are built in a number of types but those most commonly used for cranes and elevators are the high-torque, wound-rotor or slipring motor and the high-torque squirrel-cage motor. These motors are rated on an intermittent basis such as 15, 30 and 60 minutes. Fig. 5 shows a close-up of a foundry crane equipped with a.c. motors and solenoid brakes.

Where speed control is desired such as in foundries, machine shops, etc., the cranes are equipped with slipring motors. Very good torque speed curves are obtained by inserting different values of resistance in the rotor circuit of a slipring motor. For the hoist motion of a foundry crane it is preferable to use a solenoid load brake in conjunction with the motor because a solenoid load brake can be so connected that it puts an artificial load on the motor in the

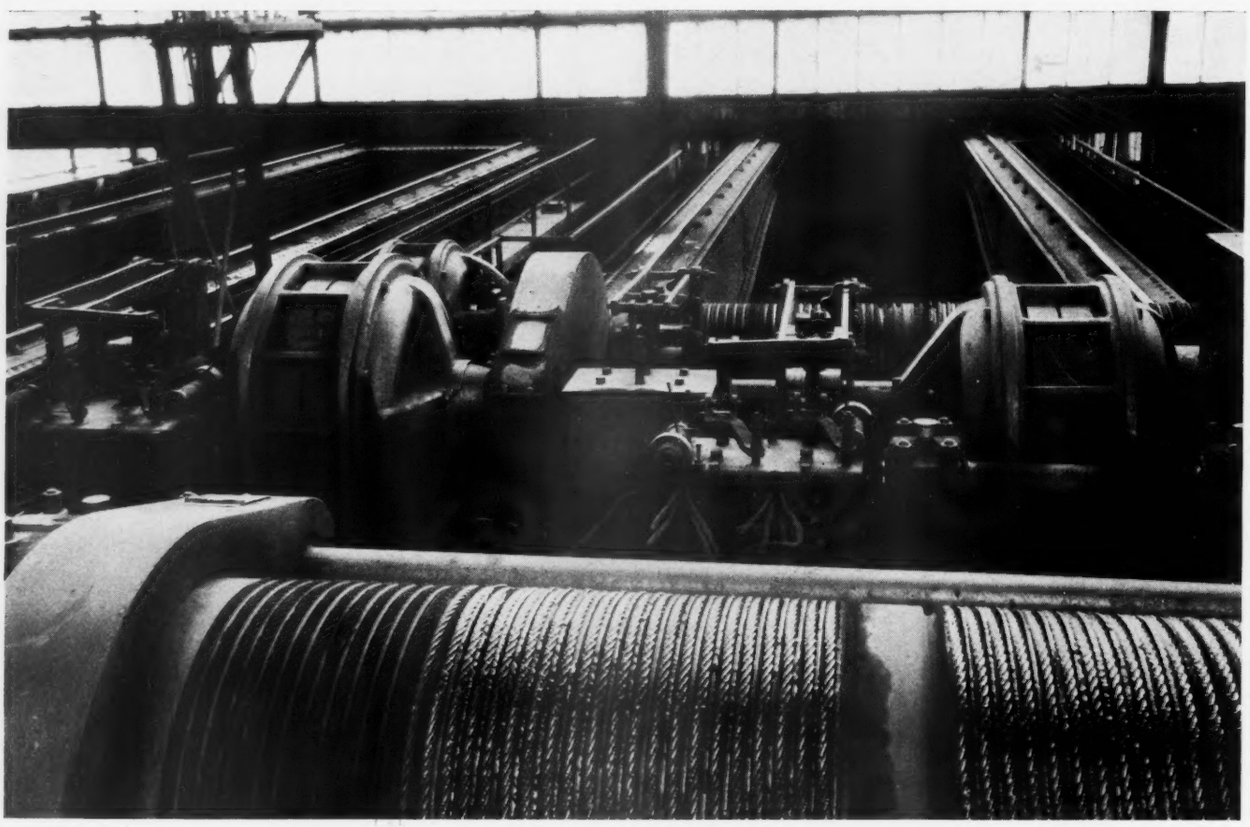


Fig. 5—A foundry crane equipped with a.c. main and auxiliary hoist equipment.

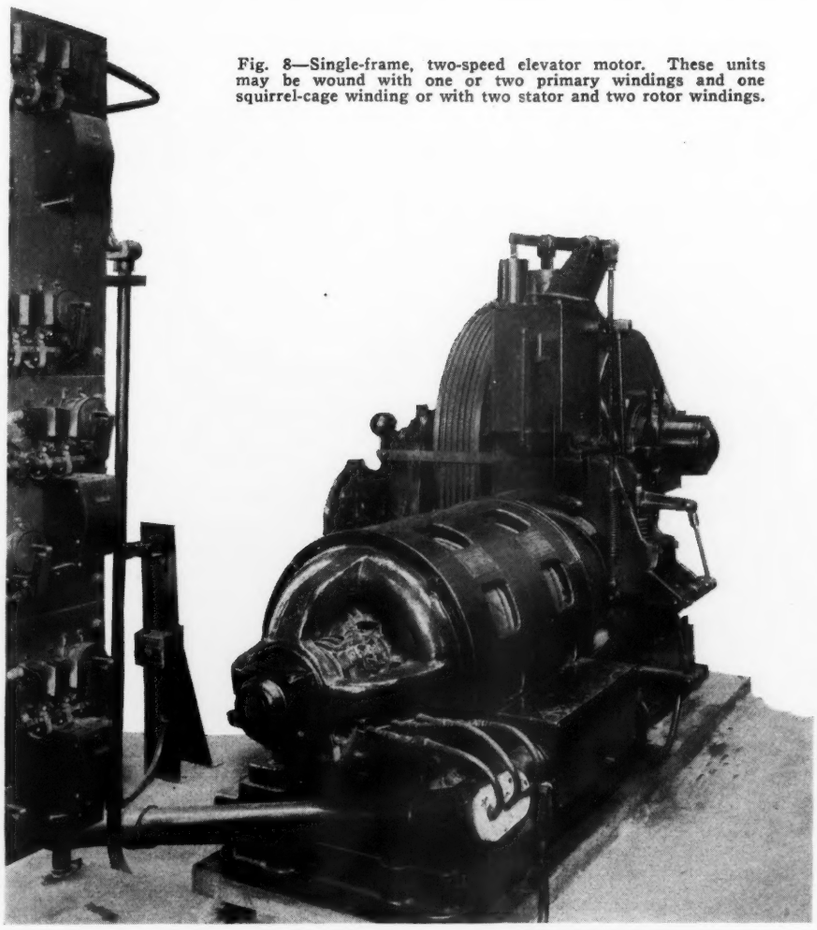


Fig. 8—Single-frame, two-speed elevator motor. These units may be wound with one or two primary windings and one squirrel-cage winding or with two stator and two rotor windings.

hoisting direction as well as in the lowering direction. Loading the motor in this way provides excellent speed regulation for light loads as can be seen by referring to the curves in Fig. 6. The curves above AB are for hoisting and those below are for lowering.

Dynamic braking cannot be applied to induction motors without complications, therefore, on practically all cranes an automatic mechanical load brake or a solenoid load brake is used in conjunction with the hoist motor. The reason a load brake is necessary is that without it an overhauling load might drive the motor at a dangerous speed if resistance is inserted in the rotor circuit and, furthermore, the motor speed cannot be reduced below synchronous speed in the lowering direction without some kind of braking. As stated previously under d.c. motors it is necessary to put an artificial load on the motor and this is usually done by using an automatic mechanical load brake or a solenoid load brake. The main operating difference between the aforesaid brakes is that with the former the friction is produced whenever the hoist block or hook is lowered, that is, power is required to drive the load down while with the latter, friction is produced only when the hoist hook is lowered at slow speeds. At other times the motor runs at or near synchronous speed and if the load is heavy enough to drive the motor it will act as an induction generator returning power to the supply line.

Motors Used When Speed Control is Not Required

Where no speed control is desired squirrel-cage induction motors are sometimes used. Motors up to 10 hp. in capacity when used for this purpose are usually thrown directly across the line. Care must be taken, however, when applying squirrel-cage motors to the trolley motion because the motor might exert sufficient torque to slip the wheels. If there is a tendency to slip the wheels the starting torque of the motor should be reduced and this is done by inserting resistance or reactance in the primary circuit of the motor. Inserting resistance will also lower the motor speed, as shown by Fig. 7, but the speed regulation will be poor, that is, the speed will be low for normal load and high for light loads.

The type of induction motor for elevators depends to a large extent on the speed of the elevator car or cab and the class of service for which it will be used. Single-speed squirrel-cage motors are used for low car speeds such as from 100 to 150 ft. per min. From 150 to 300 ft. per min. it is recommended practice to use 2 to 1 or 3 to 1 speed motors. From 300 to 500 ft. per min. a 4 to 1 or a 6 to 1 speed squirrel-cage motor should be used, depending on the accuracy of landing that is required.

Some freight elevators require a landing speed as low as 10 ft. per min. to line up the ends of a track to run cars onto and off of the elevator and where such a low speed is required the top or running speed is limited by the speed ratio of the motor. With a 2 to 1 motor the running speed would be about 20 ft. per min. while with a 6 to 1 motor the running speed would be about 60 ft. per min. Two-speed motors may be made in one frame, as shown in Fig. 8, with one or two primary windings and one squirrel-cage winding or in one frame with two stator windings and two rotor windings. The latter may have a squirrel-cage rotor for low speed and a polar-wound rotor for high speed. Usually the elevator is started with the high-speed motor and is stopped from a low landing speed by de-energizing the high-speed

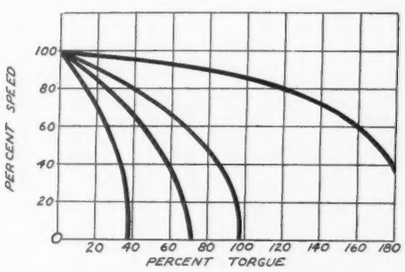


Fig. 7—Torque speed curves of a high-torque squirrel-cage motor with different values of resistance in the primary circuit.

winding and energizing the low-speed winding just before it is desired to stop. The advantages of a slipring motor are smooth acceleration and less power consumption during acceleration.

For both cranes and elevators the d.c. motors have a slight advantage over the a.c. motors but if a.c. power only is available it has been demonstrated by numerous installations that it is unnecessary to convert it to direct current for successful and economical operation.

AROUND *the* WORKS

THIS SECTION is especially devoted to short articles describing ideas and practical methods devised to meet particular operating conditions. The items may refer to mechanical details of installation, inspection, testing, wiring, repair, maintenance, replacement, and emergency or unusual installations of equipment tributary to production. Special attention is given to shop or bench tools and short cuts or improved methods of handling work brought into the repair shop. Contributions from our readers are always welcome.

Preventing Condensation Forming on Ceilings

WE experienced considerable trouble with condensate forming on the ceiling in one of the work rooms in which it is necessary to maintain a relatively high humidity.

This room extended to the roof in a single story building. The roof was of the monitor type with glass and tile exposure. In cold weather the condensate dripped from the ceiling in such quantities as to interfere with the process which was being carried on in the room.

After estimating the cost of a false ceiling, and finding it to be exceedingly expensive, it was decided to try heating the roof with unit heaters.

The heaters were arranged near the ceiling in such a way that all parts of the roof were swept by currents of warm air.

This overcame the difficulty at a considerably lower initial cost and, as the heat was on only during cold weather, the operating cost was less than would have been the cost of lighting the room had a false ceiling been installed.

Birmingham, Mich. F. H. L.

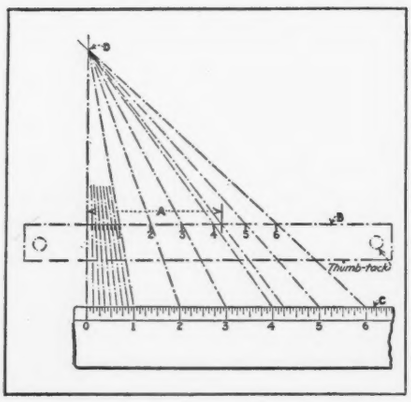
Scale for Unscalable Drawings

OCCASIONS arise in the drafting room and the shop, when it is desirable, and even necessary, to scale photostats and drawings received from outside sources. Photostatic copies of drawings are seldom reduced to a convenient or workable scale, and it is a dangerous practice to scale important dimensions.

Perhaps, the greatest difficulty is encountered when a draftsman desires to revise, or add sections and details to a print of foreign origin, possibly in metric dimensions. In some cases proportional dividers may answer the purpose, but usually this is a laborious and unsatisfactory method.

As a solution of these difficulties, I offer the simple method of making a proportional rule that will be accurately calibrated to the scale of the drawing or photostat, as shown in the illustration in this column.

In practice, any convenient dimension is selected from the drawing to be scaled. In this particular case, the dimension is assumed to be 4¼ in. Its



Proportional scale for scaling photostats, or metric drawings.

actual measurement, 3 in., is transferred to a rectangular strip of cardboard with a pair of dividers, as shown at A. For convenience, the cardboard strip should be thumb-tacked to the drafting board.

At any distance below the line *B*, and on a plane parallel with *B*, a standard scale is laid in such a position that its zero dimension will be directly below the left point of the dimension *A*. A vertical line is drawn through these two points. A second line is then drawn from a point on the standard scale, equivalent to the dimension *A*—in this instance, 4¼ in.—through the right point of the *A* dimension on the cardboard scale. From the point where the two lines converge, at *D*, lines may be drawn through other dimensions on the standard scale, and they will be directly proportional to the lines on the cardboard one.

PETER HAGEN
In *American Machinist*
Department of Enginering,
U. S. Navy Yard, Philadelphia, Pa.

Additional "Around the Works" Items will be found on page 91

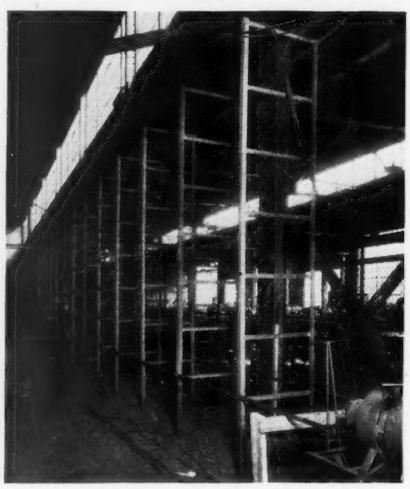
Seventy-two Bins in This Welded Structure

IN one of the parts storerooms in the plant of The Lincoln Electric Company, Cleveland, Ohio, a section of shelving of six tiers, 50 ft. long, forming 72 bins, was required for storing small parts. It was found most economical and satisfactory to construct the framework of this shelving of standard structural steel shapes, fabricated by arc welding. The accompanying photograph shows the framework of this shelving partly completed. The framework is 12 ft. high and 2 ft. 6 in. deep, giving each of the bins a volume of 20 cu. ft. of storage space.

As illustrated, the framework consists of rectangular frames set on end and tied in by longitudinal bars welded to their front and back edges. These are composed of 2x2x¼-in. angles, which form the uprights, and 1½x1½x 3/16-in. angles welded to the upright members. The longitudinal tie bars, which tie the rectangular frames together to form the complete framework, are 1¼x¼-in. flat bar stock. To form support for the floors of the bins, and also to provide the framework with additional stiffness, 1¼x¼-in. flat bars are welded to the horizontal members of the rectangular frames, equidistant between the vertical members.

To complete the shelving, expanded metal lath is welded to the framework to form the back and sides of the bins. The floors of the bins are of 14-gage sheet steel, welded to the framework.

The fabricating of the framework by the welding process eliminated the necessity of punching all members.



Welded structure containing seventy-two bins.

LIGHTING *the way to* FEWER ACCIDENTS

By R. E. SIMPSON

Engineer
The Travelers Insurance Company
Hartford, Conn.

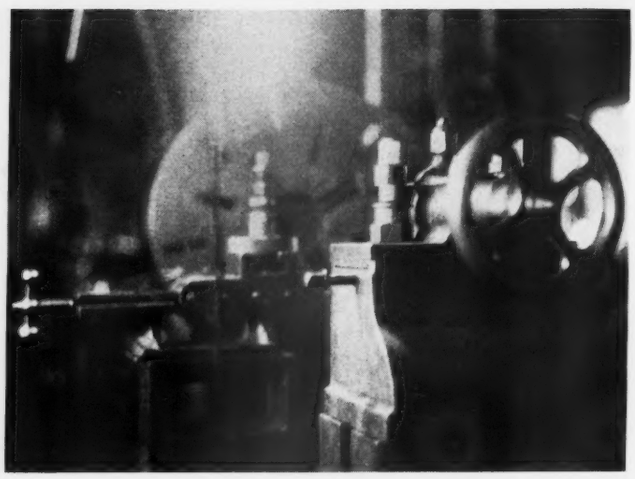
CASUALTY insurance companies have learned that it is cheaper for employers to prevent accidents than to pay for them. To the layman this may seem to be propaganda inspired by selfish motives, for in these days of almost universal state compensation laws, accident claims must be paid by insurance companies and, therefore, every accident prevented means a saving to the insurance carrier. In the majority of cases, however, compensation payments constitute the smallest part of the total amount saved; in other words, in the event of an accident the cost to the insurance company for all legal compensation claims and medical fees will average only 20 to 25 per cent of the total cost to the employer.

This is in accordance with the 4-to-1 principle promulgated by one of the largest insurance companies after a thorough investigation of thousands upon thousands of accident claims. From this survey it was found that for every dollar paid by the insurance company in full settlement of compensation claims, medical fees, and hospital charges, the employer must pay on an average at least four dollars for the uninsurable or hidden costs. These incidental costs are made up of one or more of the following items:

1. Lost time of injured employee.
2. Time lost by other employees who stop work,
   - (*a*) out of curiosity,
   - (*b*) out of sympathy,
   - (*c*) to assist injured employee,
   - (*d*) for other reasons.
3. Time lost by foremen, supervisors, or other executives,
   - (*a*) assisting injured employee,
   - (*b*) Investigating cause of accident,
   - (*c*) arranging for production to be continued by some other employee,
   - (*d*) selecting and training new employee to replace
   - (*e*) preparing state accident reports, or attending hearings before Industrial Commissioner.
4. Time spent on case by first aid attendant and hospital department staff, when this time is not compensated by insurance.
5. Cost due to injury to the machine, tools, or other property, or to the spoilage of material.
6. "Hidden" cost due to interference with production, failure to fill orders on time, loss of bonuses, payment of forfeits, etc.
7. Cost to employer under employee welfare and benefit systems.
8. Cost to employer in continuing wages, in full, of the injured employee, whereas the services of an employee who has not fully recovered may be worth only 50 per cent or less of their normal value.
9. Cost due to the loss of profit on injured employee's productivity and on idle machines.

Inadequate overhead illumination and glaring droplights always make a bad combination.

A good example of the Dark Ages in illumination in a present - day manufacturing plant.



One of the greatest enemies of keen eyes and accurate workmanship—a glaring, unshaded drop light.

These items represent little that is forward, productive, or creative. For the most part they are concerned with the repair or mending of that which has broken down. This situation is certain to continue so long as we have accidents at our present rate, and that accident rate will show no appreciable reduction until employers seriously set themselves to the task of ascertaining the basic causes of accidents and devising proper remedies.

One of the known basic causes of accidents is improper or inadequate illumination. It operates in a twofold manner: First, wherever the illumination is insufficient to disclose a hazard an accident will inevitably occur. Second, improper illumination causes eyestrain and eventually brings about defective vision; thus our greatest safeguard—our ability to see—is greatly reduced, even when adequate illumination is provided later.

The modern, unshaded Mazda lamp, particularly when within the line of vision, is a direct source of glare and, therefore, represents a violation of good lighting principles. Approximately 50,000,000 lamps are now installed in our industrial plants, but less than 25 per cent are equipped with proper reflectors. The remainder either have no reflectors of any kind, or merely those of the obsolete, shallow-disk type. Workers appreciate the handicap of the unshaded lamp within their range of vision, for I have seen countless drop lamps shrouded in pieces of brown wrapping paper or newspaper; on one occasion I found a 100-watt Mazda lamp with one-half of its surface coated with *laundry soap!*

Let us consider, briefly, three accidents and the proportion of the cost borne by the insurance company and the employer, respectively.

A number of molders were engaged in tamping sand into flasks. Limited space made it necessary to stack the flasks in tiers close to an industrial railway track, until they could be transported to the casting department. A motor car pushed a number of small flat cars against a stationary, upright-ingot car, whereupon the flat cars, buckling laterally, collided with the tiers of prepared flasks and toppled them over.

One of the falling flasks grazed the leg of a workman and caused a slight skin abrasion. This necessitated a trip to the first aid room, but the workman lost no time other than this, and no compensation was paid. There was some damage to the track and the cars, and the molds were completely broken up. The cost of making repairs, retamping the flasks, and changing the schedule in an effort to save part of the molten steel ready for pouring, amounted to more than $1,000 in this case.

A faint degree of illumination came from dust-covered overhead lamps, supplemented by local lights here and there. A 100-watt, bare Mazda lamp was suspended about 7 ft. above the ground, where the flasks were assembled and tamped. This lamp was about 15 ft. from the rail-

way track, and the shadow cast by the tier of prepared flasks hid the heavy, ingot car from the motorman's view. Clearly, the lack of adequate illumination (or the prevalence of deep shadow) was the principal cause of this accident.

Two accidents that occurred in metal-working shops, were almost identical as to cause and result. In one case (the second accident in our list), local drop lamps with pear-shaped reflectors were used to direct the light onto the machines. There was no overhead lighting, and the local lamps provided little illumination in the aisle between the machines.

A department runner carrying a box of bolts on his shoulder, failed to see an obstruction in his path, because of the poor light, and stumbled over it. The bolts were strewn promiscuously on and about the machines and the floor, and before the operator could grasp the situation and shut off the power, one machine less than a year old and costing $3,500 was utterly ruined. The runner received injuries in the form of a badly crushed ear and a cut cheek, when the box came in contact with the machine. The cost to the insurance company for medical attention was $32 in this instance.

The third accident occured in connection with six, semi-automatic, group-driven machines. Repairs were necessary; so, the power was shut off and two workmen started to disassemble one of the machines. At the same time, another workman was engaged in cleaning and oiling the remaining machines. In the course of his work he needed a certain tool, and when reaching for it accidentally closed the safety switch, thus starting all the machines in the group. Before the power could be shut off, the two men working on the partly disassembled machine were injured—one had part of a finger severed and the other received a flesh cut on his arm and a badly bruised foot.

The compensation and medical charges for the injured men amounted to $317. The disassembled machine had to be sent to an outside shop for repairs. The cost to the employer was in excess of $1,700, including the loss of production on the idle machines and the expense resulting from the interruption of the operating schedule.

One 100-watt, bare Mazda lamp was suspended just above the working level of each machine, in such a position that after a short time the man doing the cleaning was partially blinded by the bright light. Furthermore, the lamp was so located that the frame of the machine cast a shadow on the safety switch. Therefore, in order to get the required tool the cleaner was obliged to depend on his sense of touch rather than his ability to see, and consequently grasped the wrong handle, with the result that we have seen.

A sum in excess of $10,000 was the total hidden or uninsurable cost of these accidents—a sum sufficient to purchase 250,000 kw.hr. of electrical energy for lighting, at 4 cents per kilowatt-hour. The managers of these three plants would undoubtedly be disturbed by the thought of $10,000 added to their combined lighting bills. However, this sum would have paid for additional electrical energy which, if properly applied, would have adequately lighted any one of these plants for ten years, or all of them for two and one-half to three years. In that time, in all likelihood, the accident experience would have been such as to bring about a substantial reduction in the insurance premium, production would have increased, and spoilage decreased. Instead, this money was spent with nothing creative to show for it—merely damaged apparatus restored to its original condition.

The lesson to be derived is that economizing on the lighting bill at the expense of safety or production, is not saving. It produces a liability—not an asset.

Whatever accidents occur in this plant cannot be blamed on poor illumination.

PLANT · ENGINEERS' · FORUM

Heretofore *"Are You Ready for the Question?"*

Here is the seventh of a series of questions, each of which has at least two sides. A new question will be presented next month, and our readers' answers to previous questions also will be published. Write down your opinions and send them to the editor. Answers published will be paid for at an attractive rate.

HOW SHALL EQUIPMENT BE PURCHASED?

About the middle of last year Industrial Engineering's readers were introduced to two men who have since become their fast friends. These men are Frank Fulleger, a young plant engineer, and George Shipman, a works manager past middle age. They do not work in the same plant. Fulleger is constantly running against new problems, which he talks over with his friend Shipman, who has the advantage of years and experience.

Many plant men whose opinions we value have discussed the problems presented by Frank and George in these pages. The editors now take advantage of the opportunity given by this, the first appearance of the two characters in 1930, to invite this group of men to continue their contributions during the new year. They also invite new subscribers, and old readers who have not as yet advanced opinions, to take active parts in the discussion of these important problems.

* * * *

"Well, Frank, this looks like a good day for fish," said George, as he drew up the final bite in the anchor rope and began preparing his tackle.

"I hope you're right," returned Frank, struggling to get his hook into a large and lively minnow, which seemed equally determined to prevent his doing so.

"That's a nice outfit you have, George. Where did you buy it?"

"Oh, I picked it up here and there as I ran across pieces that struck my fancy. It's all right except that the reel doesn't exactly fit the rod; but by watching it I am able to keep it from falling off."

"Now that doesn't seem like you, George. If anyone had asked me I'd have said that you would buy a fishing outfit as a unit—then you'd know each part suited every other. And that reminds me of something I've been thinking about at the shop. Should we pick up a flock of things that seem to suit our fancy, or have attractive low prices, and make them into a working unit, or should we buy a complete unit ready to operate?"

"For example, Frank?"

"Well, for example, consider a painting system, with its oven, conveyor, dip-tank, drying system, and so on. Or a parts washing system. Or a conveying system. You don't even have to go that far. How about buying a machine one place and a driving motor at another and then putting them together? Or buying machine and countershaft separately?"

"In many instances, Frank, our purchasing department shows that substantial savings may be made by ordering directly from the original source, instead of paying one manufacturer to get the parts together for you."

"Yes, but aren't you penny wise and pound foolish when you do that? Doesn't the cost of your work and your delays more than offset the money saved in purchasing?"

"Not so fast, Frank, not so fast. I have some fairly well defined opinions on your question, but it won't do you any harm to do some more thinking yourself. Just keep these questions in mind while you're doing it:

"As a rule are such units as you are worrying about available as units?

"What effect will buying complete units have on your shop standards?

"If the unit is let to one contractor, and he has to buy from several sources, don't you pay his overhead?

"If let to several contractors, who is responsible for the unit as a whole?

"Is the unit manufacturer as capable of selecting other manufacturers' parts as he is of designing his own?

"If you do the planning and assembly yourself are you applying the several parts to best advantage?

"Can you do the work of assembling as economically as the outside contractor, and can you obtain the necessary skilled labor?

"Does the average manufacturer or contractor want to install the unit complete, or does he prefer to do only the part in which he specializes?

"How about ——"

ZZZZZZZZZZZZZZZ goes Frank's reel!

"Let him have it, Frank. Don't get anxious. Let him have it. Boy, he's a brute ——"

That ends it. No more shop while the fish are biting. But even so Frank and George have given us a lot to think about.

* * * *

Ordinarily a list of questions designed to guide the discussion appears at the end of these one-act plays. In this case such a list is unnecessary. The questions are all in the act. Of course you are not limited to a discussion of the points raised in the questions asked by George. Any point that bears directly upon the main topic may be discussed. Let the editor have your opinions within the next three weeks.

* * * *

READERS' ANSWERS

to previous questions

Who Shall Do the Salvaging?

(Question Presented in the December Issue)

SALVAGING may come under the stores department, the master mechanic, or the plant engineer. If under stores, the salvaging crew should sort everything, returning to the regular stock bins those items that are in good condition and which will be used. Whatever appears to be scrap, or obsolete, should be put aside for others to pass upon. The master mechanic, or plant engineer, should inspect the mechanical items, such as piping and fittings, pulleys, shafting, belting, etc. The electrical superintendent should judge anything pertaining to electrical equipment.

If the salvaging comes under the master mechanic, he, too, should see that all collections not within his immediate province are looked over by others, the regular stores items to be put back into stores.

The salvaging, or junking, of small items usually can be left to those under whose departments they fall. Large items, or whole units, should be considered by the management. When junking a whole unit, if there are more of the same type in operation, good repair parts should be saved to keep the others in repair.

Serviceable repair parts should be put into the active stores, otherwise new parts, in most cases, will be used.

If there is enough dismantling of equipment a special salvaging crew may be employed advantageously. Under any circumstances this work should be carried out under the supervision of the maintenance head. Then why not let the maintenance crew do it, even though additional help is required for a time? Doing so would make the workmen more familiar with the intricacies of equipment. At times it may be of advantage to salvage parts from machines.

Sometimes the cleaning gang can be used to sort objects for those with the proper authority to pass on.

In the reclaiming of old machines, one should not let his imagination or desire to make a big saving control the decision. There are many things to consider, such as the difficulty of obtaining repair parts; their cost; the cost of maintenance; the quality of the finished products; and the space occupied in relation to new equipment that will produce as much or more.

MARIN PHILLIPS, *Electrical Supt.*
International Paper & Power Company
Niagara Falls, N. Y.

IN my opinion the question of salvaging depends upon several factors. Some of the factors to be considered are the size of the plant; the nature of the industry in question; the amount of material accumulating; the location of the plant.

In a small plant, the plant engineer from time to time can inspect the accumulated material and, with the assistance of one or two laborers, make final disposition of the material, selling the junk iron, brass, copper, etc. In a large plant a gang can be kept busy continually, salvaging partly worn material such as pipe, valves, belting, shafting. Partly used machinery that is of no further use to the plant usually has a commercial value and should be turned into cash.

Obviously a chemical plant or a cotton mill will have a somewhat different line of material to be handled than would a steel mill or a foundry. Likewise, a small plant located in an isolated community far from the industrial centers has a problem different from

that of a large plant in any one of our larger cities. In general, however, most industrial plants have just about the same problem to solve in disposing of surplus or obsolete material as well as junk which is of no further value except to be run through a steel mill or foundry for refabrication.

Without question, the master mechanic or chief engineer should decide what disposition is to be made of the material and all that can be put back into service should be overhauled and stored away until needed.

CHAS. A. PETERSON, *Chief Electrician*
Cold Spring Granite Co.
Cold Spring, Minn.

IN large industrial plants that contain many different types of power and production machinery it is good practice for the man in direct charge of power-producing and power-using equipment to recommend its replacement or continued use. He knows, or should know, whether such machinery is safe and economical.

In regard to the production machinery, the production manager should know if a replacement of certain equipment would result in increased production at less cost and, if so, should recommend accordingly. The final decision, however, should come, generally, from the general manager or board of directors.

The maintenance men should dismantle their own equipment whenever it is practicable for them to do so, and in most places it is. The salvage parts should not go into regular stock because, even though in good repair, they are not new, and the regular stock usually is. They should be kept in a separate place.

R. G. SPOONER, *Plant Engineer*
Nashawena Mills, New Bedford, Mass.

Who Shall Do the Oiling?

(Question Presented in the November Issue)

IN these days of high-speed machinery and close competition, transmission equipment shut-downs are very costly and shut-downs from failure to properly lubricate this type of equipment generally cause expensive delays in production as bearings, scored shafts, and worn gears cannot be replaced in a minute.

The lubrication of transmission equipment should be done by a trained man, or by a gang in charge of a man who reports directly to the master mechanic.

When the lubricating of equipment is left to the operators of the various machines, it is generally only half done, and poorly at that. The operator is usually on a piece work rate, and does not want to spend much time and effort in work other than in his particular part of the production.

The lubricating gang is carefully instructed in the use of high-pressure lubricating equipment, and concerning what parts of the machines need the most attention, what lubricants to use, and in what quantities.

A few years back the "oiler" had a collection of squirt cans, and would go here and there giving the bearings a passing acquaintance with oil, and trusting to Lady Luck that someone would catch sight of a hot bearing before much damage was done. There were oil cups or oil holes to pour the oil into, but he had no positive assurance that the bearing was getting a sufficient supply of lubricant, unless he put in enough to have some run out of the bearing. The excess usually dripped on the material in process of production. With the introduction of the modern high-pressure methods of lubrication these unreliable and messy methods were eliminated.

In the steel plant where the writer is employed there are a number of old-type electric traveling cranes of from 5 to 50 tons capacity. They were originally equipped with grease cups and oil holes. The maintenance cost of bearing and shaft replacements ran into a large amount of money. The crane operators were held directly responsible for greasing their cranes, but all kinds of reprimands were of no avail, as these operators would not spend the time to properly lubricate their equipment.

Three years ago all the cranes were equipped with high-pressure lubricating systems. The lubricating was put in charge of one man, who goes over each crane carefully each day. He has a printed form with the bearings of each crane listed. Once a week he measures the wear on each bearing, on every crane, and records it on the printed form. This form is sent to the chief electrician who can, at a glance, see which are the worn bearings, and check on why some bearings wear down sooner than others.

A careful record has shown that this system has reduced to a very small amount the maintenance costs and shut-downs of these cranes, and has also reduced the costly inventory of spare parts.

W. D. BRISTOW, *Chief Electrician*
Washburn Wire Company
Phillipsdale, Rhode Island

Who Shall Do the Welding?

(Question Presented in the September Issue)

IN many industries welding, when first introduced, is primarily to replace riveting, or at least a part of it, but when it is seen in its broader scope its possibilities become almost countless. However a costly condition to guard against is that of letting maintenance men assume an altitude of "Let the welder do it" for jobs where a few minutes of drilling or chipping will accomplish the results without delay.

In almost any plant there are spindles, journals, and shafting that require straightening. This work can be done in place, or near the point of operation, with portable equipment, saving considerable time.

Another important part that the electric welder can play is that of filling in shafts and spindles that have become worn excessively at their journals, thus often saving many hours in labor and cost of new material which would otherwise be required. A bracket or bearing will sometimes break off from a casting and replacement is made simple through welding.

Changes and alterations, that are taking place almost continually in a moderate size industry, call for the removal and salvaging of a steel member, or casting.

(Please Turn to Page 103)

AUXILIARY DEVICES

Insure Safe Delivery of Goods

IN MATERIALS HANDLING SYSTEMS

By J. C. SIEGESMUND

Assistant Chief Engineer
Eli Lilly and Company
Indianapolis, Ind.

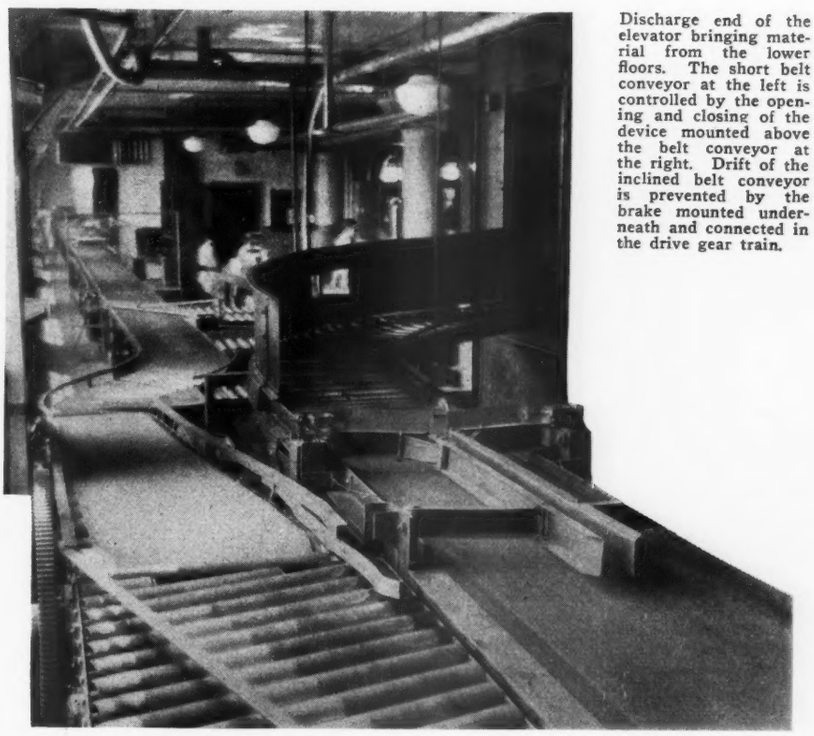
AS with all successful control systems where *each function is correctly performed before the succeeding operation takes place,* so it is with extensive materials handling systems that depend upon auxiliary devices for the safe delivery of finished fragile products at the proper destination.

In the preceding article which appeared in the November issue of INDUSTRIAL ENGINEERING it was brought out how we used certain auxiliary devices in conjunction with our conveying system to speed up the delivery of crude product to manufacturing points. This article is intended to describe the application and use of other auxiliary devices that are employed in conjunction with other elements of materials handling systems that enable us to deliver the finished fragile products to stock room and shipping platform with comparative safety.

Spiral conveyors are used chiefly in transporting materials from upper to lower floors. Formerly when materials were fed to the same spiral simultaneously from two floors considerable caution was necessary to prevent severe jams and resultant damage to the goods in the spiral. After a few experiences of this kind simultaneous feeding was discontinued at the expense of delayed production and considerable overtime in handling the material from each floor at a time.

As it was brought out in the previous article, this materials handling system was designed and installed without any additional features. The adoption of auxiliary devices is the result of experience, more or less, gained in the operation and maintenance of the equipment.

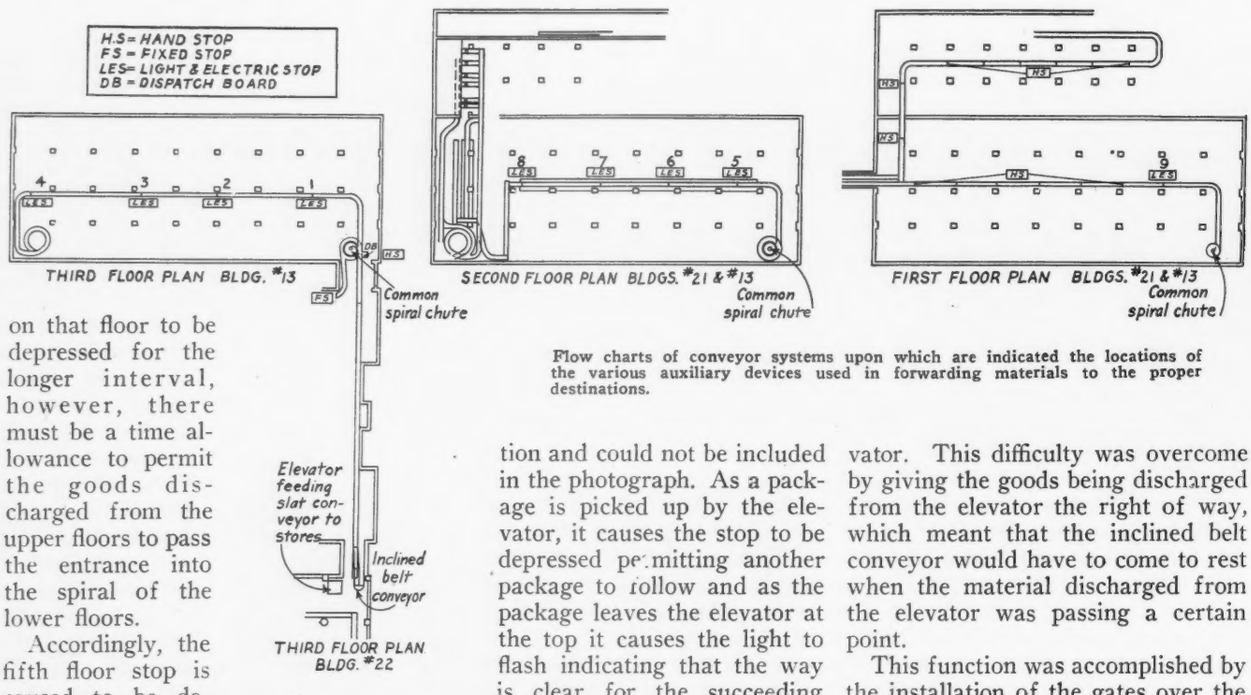
Lack of adequate signaling devices and inability of men to observe material flow simultaneously from two upper floors were responsible for the addition of the auxiliary device on the spiral in question. It extends from the fifth floor to the basement but only the fifth and fourth floors are concerned since simultaneous feeding from these points is necessary at times.



Discharge end of the elevator bringing material from the lower floors. The short belt conveyor at the left is controlled by the opening and closing of the device mounted above the belt conveyor at the right. Drift of the inclined belt conveyor is prevented by the brake mounted underneath and connected in the drive gear train.

Having experienced expensive jams a program clock unit was installed, which controls stops in the conveyor systems at the fifth and fourth floor entrances of the spiral installation.

The operation of this unit is as follows: According to manufacturing operations a definite program is decided upon for feeding the spiral from each of these floors. The clock shown in an accompanying illustration controls the entire procedure through contacts, relays and electromagnets. A pin and disk arrangement shown to the right of the clock in the photograph on the following page, regulates or selects the stop to be operated. This device may be set for practically any interval of operation such as two minutes and one minute, two minutes and three minutes and so on, one disk being required for every electro-mechanical stop. Also the clock with its disks may be set to be inoperative after working hours and on Sundays or by means of a tumbler switch, the program device can be made to operate during overtime at night the same as during regular hours. If more material is to be delivered from one floor, the setting provides for the stop


H.S = HAND STOP
F.S = FIXED STOP
LES = LIGHT & ELECTRIC STOP
DB = DISPATCH BOARD
THIRD FLOOR PLAN BLDG. #13
SECOND FLOOR PLAN BLDGS. #21 & #13
FIRST FLOOR PLAN BLDGS. #21 & #13
Common spiral chute
Common spiral chute
Common spiral chute
Elevator feeding slat conveyor to stores
Inclined belt conveyor
THIRD FLOOR PLAN BLDG. #22

Flow charts of conveyor systems upon which are indicated the locations of the various auxiliary devices used in forwarding materials to the proper destinations.

on that floor to be depressed for the longer interval, however, there must be a time allowance to permit the goods discharged from the upper floors to pass the entrance into the spiral of the lower floors.

Accordingly, the fifth floor stop is caused to be depressed for a period of one minute permitting material to flow into the spiral. During this time and for an extra minute, or for two minutes the fourth floor stop is up barring the flow of material from the fourth floor into the spiral. At the expiration of two minutes, allowing the material from the fifth floor to clear the fourth floor feed-in, the fourth floor stop is caused to be depressed for three minutes permitting material to flow from this floor so that there will be no loss of time in despatching the material and, of equal importance, no damage to the material in transit. The arrangement at present is such that after the fourth floor stop has been down three minutes, both the fourth and fifth floor stops are up two minutes before the fifth floor stop is caused to be depressed. Then the cycle starts over again. Practically all of the material forwarded from these points is discharged at the third floor and thence conveyed to stock. Other material, however, is delivered by means of this spiral to lower floors but it has not been necessary to extend the control to the lower floors.

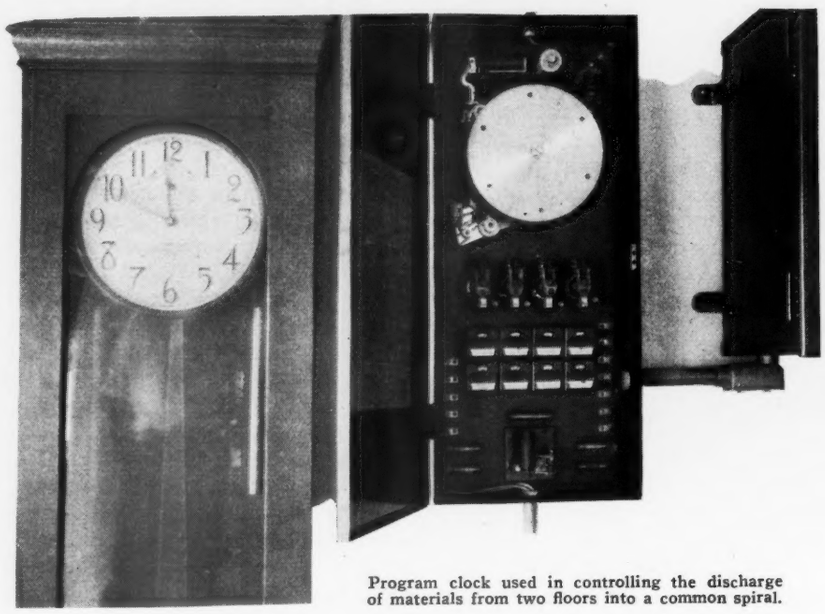
Two other views show where it was necessary to employ other means in safeguarding the delivery of materials. In the one, a light is used to indicate the safe discharge of packaged goods from the elevator, the entrance to which is controlled by a mechanical stop. The light is on the side of the elevator housing that is shown in the accompanying illustration and could not be included in the photograph. As a package is picked up by the elevator, it causes the stop to be depressed permitting another package to follow and as the package leaves the elevator at the top it causes the light to flash indicating that the way is clear for the succeeding package to follow. A push-button stop is employed to shut down the elevator in case of trouble.

The other view is that of the discharge point of this elevator and the junction of the conveyor bringing finished goods from the third floor of Building No. 22 to Building No. 13 where another traffic center is located.

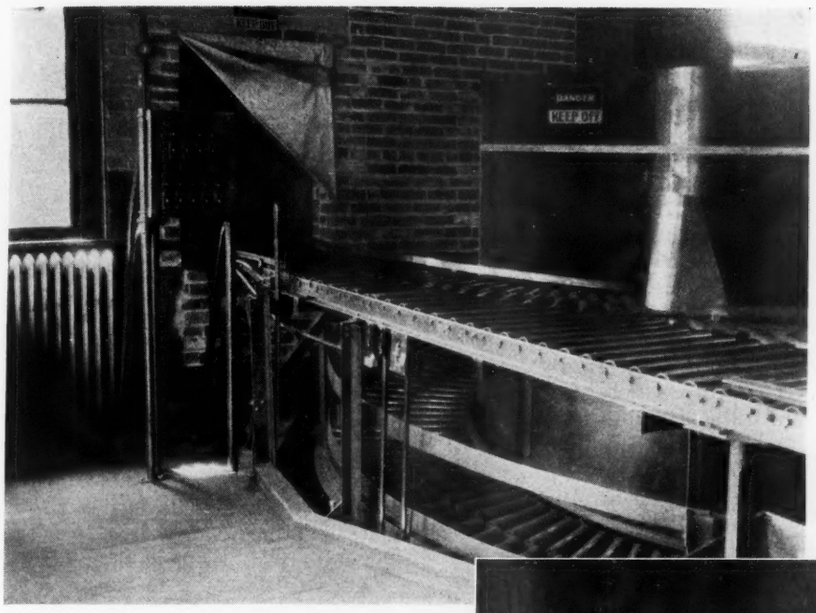
At the junction point of these conveyors considerable difficulty was experience in avoiding jams and resultant damage to the product. Material coming up the inclined belt conveyor would collide with packages being discharged from the elevator. This difficulty was overcome by giving the goods being discharged from the elevator the right of way, which meant that the inclined belt conveyor would have to come to rest when the material discharged from the elevator was passing a certain point.

This function was accomplished by the installation of the gates over the elevator discharge conveyor, and which open as material is being conveyed. In opening they cause the circuit feeding the drive motor of the inclined belt conveyor to open thus bringing this unit to rest. As the gates resume the position as shown, the drive motor circuit is closed and the belt conveyor discharges its load onto the main feed into Building No. 13. When this device was first installed there were no means provided to prevent the loaded belt conveyor from drifting backwards carrying fragile material to destruction.

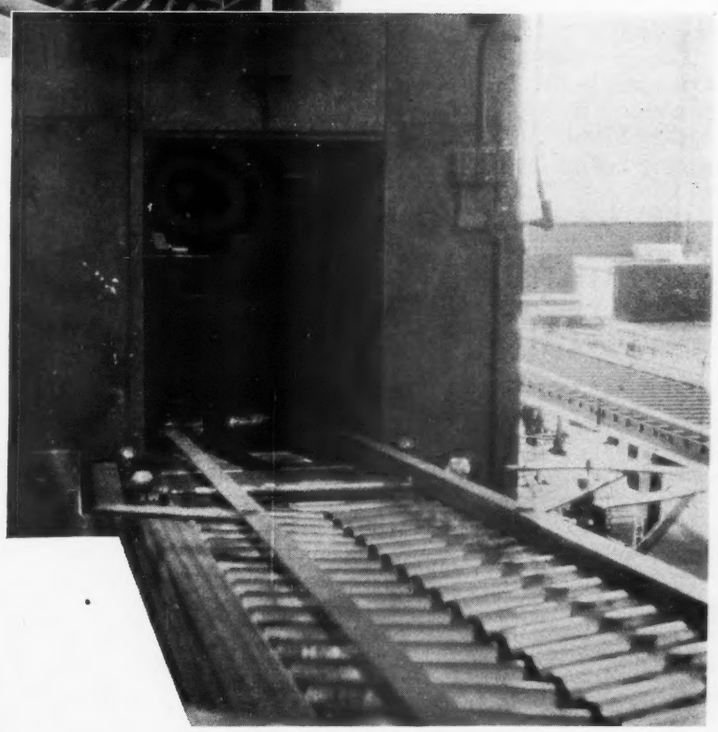
By referring to the accompanying illustration it can be seen how this



Program clock used in controlling the discharge of materials from two floors into a common spiral.

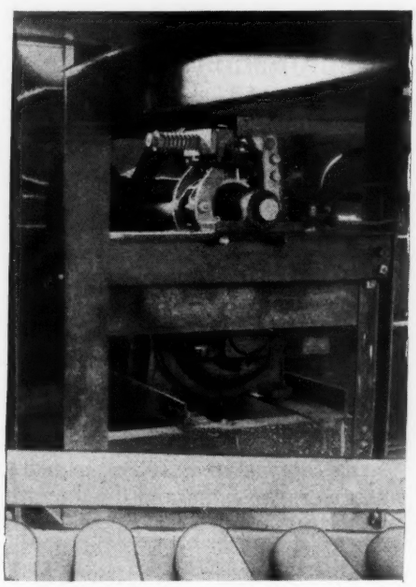


Despatch board equipped with nine controls at traffic center leading to stores.



Mechanically-operated stop in conveyor system feeding elevator used in transporting material to an upper floor. Here a light is used to indicate the safe delivery of the material at the upper floor.

problem was solved. This view shows the drive mechanism installed beneath the conveyor. The solution was found in the application of an electro-mechanical brake on an intermediate shaft in the gear train. As long as the unit is operating, the brake is held open by the current in the motor circuit, but as the gates on the elevator discharge conveyor open, the motor circuit of the belt conveyor is opened and the brake is set thereby preventing any drift that might be caused from the load on the conveyor.



Driving and braking mechanisms of inclined belt conveyor.

As the material safely passes this point it is on its way to the stock rooms or the shipping platform. Despatching to either location is done similarly to the system employed in forwarding crude materials as explained in the previous article. A despatch board having nine stations is used and which is shown by means of the accompanying flow charts. The lower floors are served from the spiral with speed and safety corresponding to that of the upper floor.

Although auxiliary devices contribute their share to the safe and speedy delivery of finished material to stock, it must be remembered that other elements contribute to the general efficiency of the system, for instance, where a quarter-turn gravity-type conveyor was installed overhead in the lower stock room without sufficient pitch to carry away the material from the spiral chute, a short belt and several rolls for friction were added and driven from an adjacent conveyor drive. Material arriving at this point was whisked around the corner to continue its safe journey to stores and ultimate consumption.

* * *

Awards for Achievement in Industry

UNDER a plan formulated by the MacDonald Bros. Engineering Laboratories, Inc., of Massachusetts, the industrialist and the man in the shop who makes the most outstanding contribution to industry each year will be awarded gold medals and substantial cash prizes.

The engineering company referred to was formed recently to erect and operate at Detroit a year-round permanent exposition of industrial tools and equipment.

This Month's Cover

SHOWN on the front cover in this issue is the plant of the Amsterdam, N. Y., Mills of the Bigelow-Sanford Carpet Company, Inc., devoted to the manufacture of Axminster and velvet rugs and carpets.

That plant engineering and maintenance constitute an important function in this plant is indicated by the following statistics concerning personnel and equipment:

There are 3,000 employees, 64 buildings with 44¼ acres of floor space and 27½ acres of ground.

The operation of 371 wide Axminster looms, 182 narrow Axminster looms, 146 wide tapestry looms, and 86 narrow tapestry looms, requires 964 motors, totaling 6,751 horsepower; 243 miles of wiring for power and light; 170,000 sq. ft. of radiation (radiators); 4 miles of steam piping; 2½ miles of water piping and 35 miles of sprinkler piping.

There are 34 elevators, 104 extensions and telephones, and 118 drinking fountains. The coal consumption is 19,000 tons per year.

The Amsterdam Mills were formerly those of Stephen Sanford & Sons, Inc., a company recently purchased by the Bigelow-Hartford Carpet Company and forming the firm now known as the Bigelow-Sanford Carpet Company, Inc.

Maintenance on Program of Management Congress

"PLANT MAINTENANCE" is to be the subject of the morning technical session of the National Management Congress on March 4. R. R. Rees, plant engineer, Packard Motor Car Company, will talk on "Organization for Maintenance." Another speaker of note will deal with the subject "Budgeting for Maintenance." L. C. Morrow, editor of *Industrial Engineering*, will preside.

The meetings of the Congress will be held in the Stevens Hotel, Chicago, March 3 to 7, inclusive. Nine sessions have been arranged, opening with an address, "Some Economic Aspects of Management in the Future," and following with addresses on "The Development of Organized Management, Science, and Philosophy since Taylor," the main theme running through the entire conference being "Organizing for Permanent Prosperity."

In the sessions other than devoted to "Maintenance," the subjects will be, "Progress in Distribution Methods," "Simplification and Mechanization in the Administrative Field," "Wage Incentive Plans," "Industrial Education and Training," and the "Machine Age."

Societies sponsoring the Congress include The American Society of Mechanical Engineers, The Society of Industrial Engineers, The American Management Association, The National Association of Cost Accountants, and the National Association of Foremen.

Exposition of Industrial Equipment

Four classifications will cover the first sessions of the Industrial Equipment Exposition to be held during the same week in the Stevens Hotel. They are:

Power Transmission Equipment
Materials Handling Equipment
Factory Operation Requisites
Management Production Control Equipment.

Much of the equipment exhibited will be in actual operation.

Plant Visits

Visits to industrial plants in Chicago will be an attractive feature of the Congress. On Wednesday, the 5th, inspection trips will be made to the plants of the Western Electric Company and the Hall Printing Company. On Thursday, visits will include trips to the plants of Swift & Company, Edison Electric Appliance Company, and Inland Steel Company. The program for Friday includes the plants of the Whiting Company, the Chicago tunnel and the State Line generating station.

Meeting of A. S. M. E. Committee on Elimination of Waste

The American Society of Mechanical Engineers Committee on Elimination of Waste will hold its first 1930 meeting in conjunction with the Congress. There will be shown some of the waste exhibit boards constructed by employees of firms that have held campaigns for the elimination of waste in their plants.

Sessions on Materials Handling

In conjunction with the Management Congress the materials handling division of the American Society of Mechanical Engineers will hold its third national meeting presenting papers on these subjects among others:

"Use of Portable Conveyors"
"Economics of the Tractor and Trailer in Industrial Handling"
"Materials Handling as an Important Factor in Plant Maintenance"
"Laying Out Proper Materials Handling Systems"
"Shipment of Goods on Skid Platforms and Safety in Materials Handling Equipment"

Elimination of Waste Awards

A CERTIFICATE of merit to the company, and a cash award of $50 to the employee of that company, submitting the best suggestion for the elimination of waste in industry, will be paid by the backers of the National Industrial Equipment Exposition to be held in Chicago, March 3 to 7, inclusive. The judges will consider the quality of the suggestion and its practical use in industry.

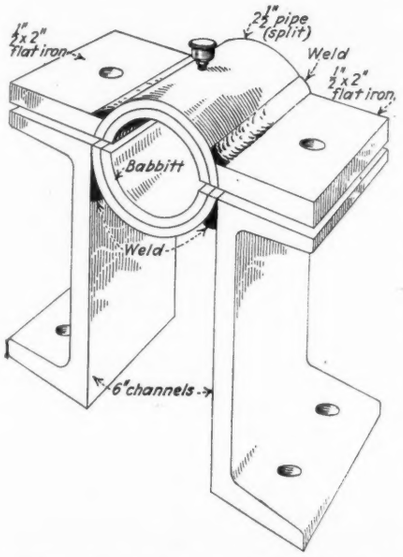
Any company may submit as many as three suggestions, and the time for their entry extends to May 30. Entries should be submitted to the National Industrial Exposition, 308 West Washington Street, Chicago, Illinois.

AROUND *the* WORKS

Emergency Pillow Blocks Made with Welding Torch

SOME TIME ago I saw two temporary pillow blocks made up from odds and ends by a welder, to keep a plant in operation until new pillow blocks could be secured.

An extension to an existing plant was being built and a lineshaft 1 15/16 in. in diameter was needed in a hurry.



Pillow block made in emergency from pieces of channel iron and pipe welded together.

Shafting and pulleys were located, but no pillow blocks could be found. The welder made up two pillow blocks as shown in the illustration and they functioned perfectly until they were removed some time later.

Chief Electrician, CHAS. A. PETERSON.
Cold Spring Granite Company,
Cold Spring, Minn.

Method of Demagnetizing Bed of Large Engine Lathe

THE manner in which we recently demagnetized a 40-in. engine lathe having a 14 ft. 6 in. bed, may help some other reader who has a similar problem.

We had on hand eight coils of No. 16 magnet wire, which had been wound on spools with a core 5⅝ in. in diameter, 1½ in. wide, and 12 in. outside diameter. Each coil contained 1,034 turns and weighed 20½ lb. We threaded these spools on a cold-rolled shaft 5 in. in diameter, and 5 ft. long, after insulating it with a few turns of friction tape. Thus there were 8,272 turns of wire weighing 164 lb. on this improvised magnet.

The shaft was then suspended from a crane so that it could be inserted between the centers of the lathe, which it cleared by about 1 in. at each end.

The coils connected in series to a 125-volt d.c. circuit consumed 350 watts. Care was taken to switch on the current when the shaft was three or four feet from the centers of the lathe. The shaft was then moved slowly with the current on, until it lay between the lathe centers, where it was held for five minutes. It was then slowly removed to the same distance, turned end for end, and again inserted as before and again removed. This procedure was repeated until six reversals had been made. Each time the shaft was taken away from the lathe before the current was shut off.

Before this treatment, it was impossible to use the lathe, as the chips stuck to the cutters and material, but when we had finished there was no trace of magnetism.

The small tools, wrenches, and so on, that had been magnetized by the lathe, were demagnetized with a growler, using standard 110 volt a.c. and moving the articles slowly through the magnetic field of the growler.

Allenby, B. C., Canada. H. T. HAYES.

Portable Winch for Moving Heavy Machinery

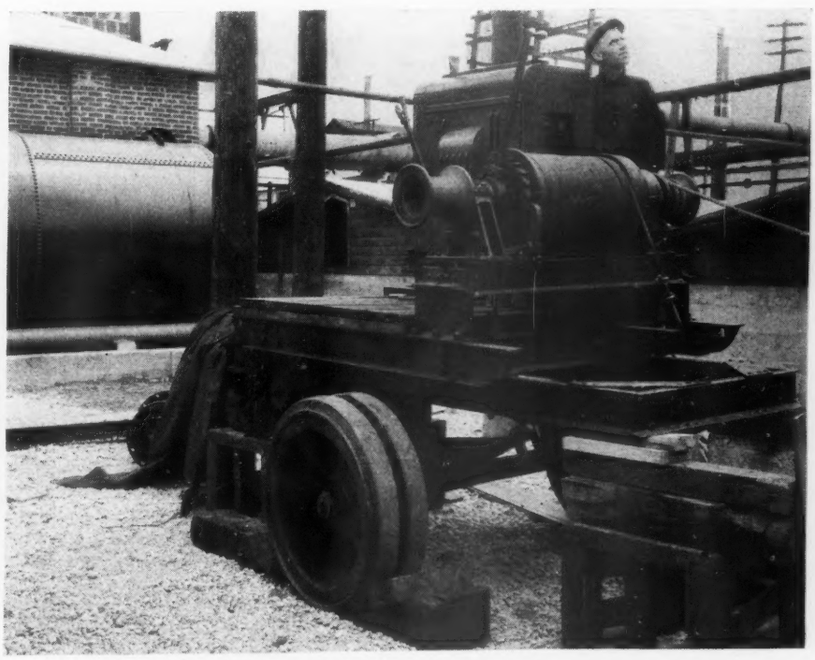
IN a large chemical plant in New Jersey, the moving of heavy machinery is almost an everyday job. Old equipment is constantly being taken out, and much new equipment is being put in, as the plant is expanding quite rapidly.

The problem of how to handle this work, with the desired speed and safety, was a serious one until the chief millwright designed and built the portable hoisting and hauling outfit shown in the illustration.

An old automobile truck was purchased for a few dollars, and the rear end cut off and used as a support for the winch. As will be seen, the frame of the truck was extended at the rear end for about 3 ft. by means of a light channel-iron framework that is bolted in place. This extension is supported by blocking, when the outfit is in use, and is arranged for coupling to a truck that moves it around the plant.

On the platform was mounted a small winch or drum driven by a 20-hp. gasoline engine. Through the use of the proper tackle this outfit has been able to handle a wide variety of heavy moving and erecting jobs. It has more than paid for itself in speeding up the work and reducing the number of men required.

New York, N. Y. G. A. V. B.



A winch driven by a 20-hp. gasoline engine was mounted on the rear end of an old automobile truck for ease in transporting it around the plant.

MODERNIZING OLD MOTOR WINDINGS

Replacing strap-copper field coils with the square or ribbon wire type

By A. C. ROE

Renewal Parts Engineering Dept. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

THE preceding articles in this series on modernizing obsolete windings have dealt only with stator or armature coils, and ignored the field windings. In this article some general data will be given pertaining to economical methods of replacing the expensive strap-copper, edge-wound field coils when rebuilding old equipment.

Strap-copper fields of the edge-wound type are found principally on revolving-field a.c. generators, and synchronous motors. This type of coil is extremely expensive to replace, but the advantages offset the high cost, except in those cases where the old equipment is to be replaced within five or ten years after repairing.

The reason for this last statement is based on the fact that edge-wound, strap-copper field coils are practically indestructible. However with modern methods and materials it is possible to replace these coils to advantage, and at lower cost, with square or ribbon wire field coils.

The following discussion will bring out the reasons for the high cost of the edge-wound, strap-copper field coil. First, the coil is wound straight up in spiral form, and as each turn has four corners, with the copper bent edgewise 90 deg. around a comparatively small radius, a bulge is formed in the flat surface of the copper at all bends and turns.

The bulge in the copper is pressed out, after the coil is wound, by inserting steel plates between each turn, and pressing in a hydraulic press; if any bulge remains after this treatment it is filed down. After removing the bulge the turns are separated and the coil is dipped in a special cementing varnish.

The insulation between turns is applied next. It consists of sheet asbestos, two thin sheets being used between each turn. The sheet material is treated on one side only, with a special cementing varnish. The material is cut into washers slightly wider than the width of the copper. The asbestos is applied with the treated sides together; thus, the untreated surface of each sheet is in contact with the treated copper surface.

The copper, with the turn insulation in place, is heated and compressed to the required dimensions, and then allowed to cool under pressure. After cooling the coil is trimmed and the final exterior insulation applied. Thus, the use of treated asbestos between turns results in a solid, compact coil with class B turn insulation.

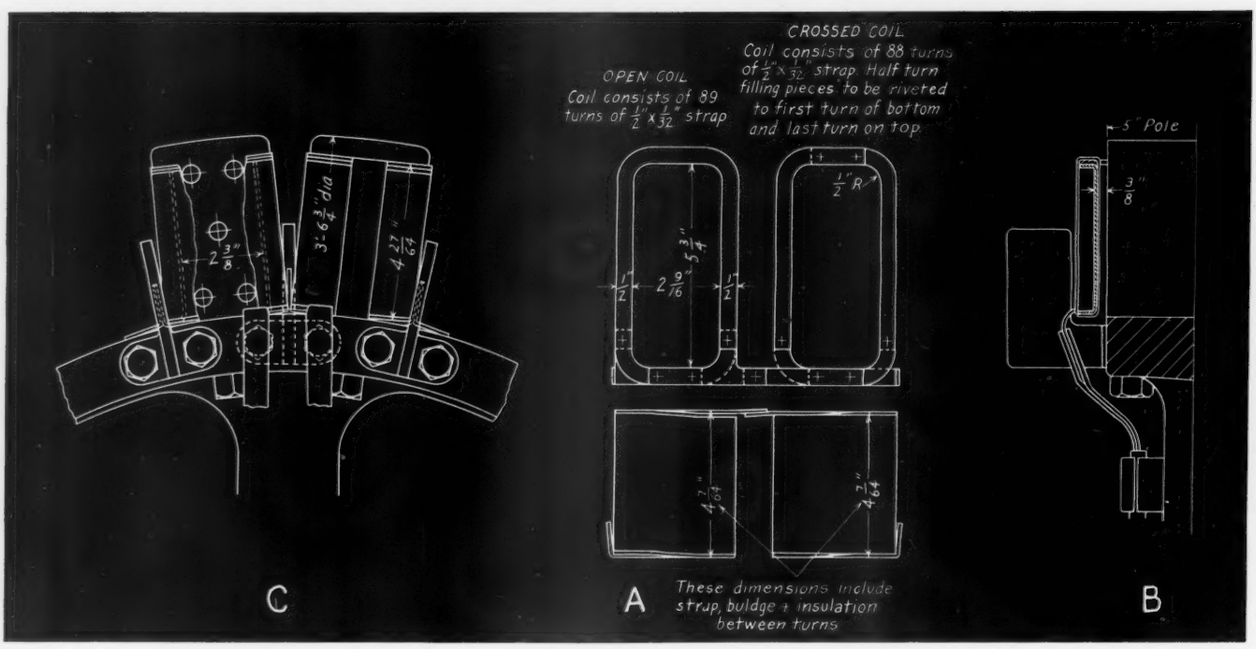

OPEN COIL
Coil consists of 89 turns of 1/2" x 1/32" strap
CROSSED COIL
Coil consists of 88 turns of 1/2" x 1/32" strap. Half turn filling pieces to be riveted to first turn of bottom and last turn on top
5" Pole
These dimensions include strap, bulge + insulation between turns
C
A
B

Fig. 1—Details of strap-copper, edge-wound field coils of 75-kva. 14-pole a.c. generator.

When considering the redesign of a strap-copper, edge-wound field coil, the importance of the turn insulation being class B should not be overlooked, and the temperature of the old coils should be checked to insure uninterrupted service from the new set of field coils.

In redesigning the strap-copper coils, the conductor is changed to square or ribbon wire, the insulating covering on the wire being either a double cotton covering or an asbestos covering, according to the service conditions and the operating temperature of the field coils. When a d.c.c. or asbestos-covered square or ribbon wire is used in the new coils a special synthetic compound is brushed on between layers as the coil is being wound, and the finished coil is impregnated in a synthetic varnish.

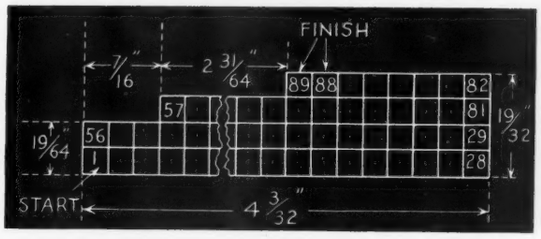


Fig. 2—Method of making tapered coil when using square wire.

This treatment insures a compact, solid coil and improves its heat-radiating properties. When cotton-covered wire is used the above treatment improves the heat-resisting qualities of the covering.

The wire-wound coils offer possibilities for increasing the clearance between adjacent coils at the smaller diameter where the polepieces are bolted or keyed to the rotor spider. The wire coils can be tapered by adding one or more layers of fewer turns to the upper section of the coil near the pole face, where the diameter is larger and the space between adjacent coils greater.

In some cases the wire-wound coils can be wound directly on the polepieces; the factory engineers can give suggestions regarding the suitability of this method for any particular machine, as it is economical only when existing insulating details, such as washers, spacers, shells and so on, that are used on current designs, are adaptable to the new coil.

In any case where the use of a wire coil is practicable as a substitute for the edge-wound, strap-copper coil, it is possible to produce a coil that will give years of trouble-free service.

To bring out some of the possibilities of changing a strap-copper coil to the wire-wound type, the following problem has been worked out:

In Fig. 1 diagrams *A*, *B*, and *C* show the field data of a 75-kva-pole generator, having open and crossed coils with 88 and 89 turns per coil of 1/32x½-in. copper strap wound on edge. Fig. 1 *A* shows that the available wire space is 4 7/64 in. and that the inside dimensions of the coil are 5¾x2 9/16 in. It will be seen from *B* and *C* that the polepieces are bolted to the spider, and that there is ⅜ in. clearance between the coil and polepiece at each end of the rotor. Diagram *C* of Fig. 1 indicates that the space between adjacent coils at the spider is small; thus the new coil should be tapered.

The next step is to develop the new coil layout. One 1/32x1.2-in. bare copper strap conductor has a cross-sectional area of 0.015415 sq. in. Trying a square wire first, we find that a No. 8 (0.129 in.) square wire has an area of 0.01567 sq. in. and an insulated size of 0.146 in. square for either double cotton or asbestos covering. Then with a wire space of 4.109 in. and a wire diameter of 0.146 in., the turns per layer will be 4.109 ÷ 0.146 = 28. Then, 0.5 ÷ .146 = 3, which will be the maximum number of layers at the bottom of the coil.

Thus, three layers of 28 turns each make a total of 84 turns per coil, making a fourth layer of four and five turns necessary to obtain the proper number of turns in the open or crossed coils. To increase the clearance at the bottom we can take some turns from the third layer and add them to the fourth.

In Fig. 2 is shown the new layout. Note that the small end is 19/64 in., or the clearance is increased 13/32 in., and the thickness of the coil is 7/16 in. at the point where the third layer starts.

By winding the coils directly on the polepiece the total length of copper per coil could be slightly reduced, as the polepiece is 5 in. long and the coil 5¾ in. Thus, at least 1¼ in. could be saved on each turn, or about 9 ft. per coil, or 252 ft. for 28 coils, and the square-wire coils could be made at a lower cost.

Thus, it should be possible to rewind both the stator and field windings of an old-type generator with modern coils at a lower cost and improve the efficiency of the unit.

Here's to the Quiet Shop

LAST fall Mayor Walker started a campaign to reduce the noise in New York City. This was by no means a new idea. It has often been advocated both from the platform and on the pages of the press. Each time some notable person brings the subject up, the public becomes mildly interested for a while but it is soon forgotten. No real concerted action has been attempted.

Perhaps one of the reasons why this problem has never received the attention it requires is that we are afraid the cost of its solution would be prohibitive. Yet there are numerous examples which indicate that noise elimination is not costly but actually results in economy.

No shop superintendent would tolerate a belt or bearing squeal. It is annoying, yes, but furthermore it indicates costly unnecessary wear on the parts and increased power consumption.

The noise, for which the earlier automobiles were noted, is absent or greatly reduced in the modern car. Yet the modern car sells for only a fraction of what was paid for the noisy ones, the performance has improved, and the maintenance cost has been reduced.

Chattering tools, while requiring less power to remove a given amount of stock, so wrack the machines that they are, in good practice, corrected at once.

Steel tired wheels on shop trucks, besides being noisy, do considerable damage to the floors and roadways.

These examples indicate what has been and can be done if the engineering brains of this country is brought to bear on the problem. A good slogan, similar to "Safety First," is needed to keep us ever mindful of the results desired. And as industry has profited through its safety program so it will profit by reducing the waste indicated by annoying sounds.

Birmingham, Mich. F. H. Low.

INDUSTRIAL ENGINEERING

Plant Engineering in Industry

L. C. MORROW, *Editor*

Chicago, February, 1930

Wanted—Non-Skid Floors

OCCASIONALLY some one hazardous condition is emphasized by being observed repeatedly within a short unit of time.

The hazards of slippery floors and steps were impressed upon an engineer recently when he visited a large number of industrial plants. His time was limited, he walked rapidly, and his shoes were nearly new.

The combination was too much for him. He slipped on stairs, on hardwood floors, on greasy floors, on lint-covered floors. And, just as he was emerging from a fine first aid room in a plant where much attention is given to safety, he slipped on a smooth iron plate at the threshold.

Wear makes floors slippery. So does oil. So do some products. That there are not more accidents because of falls brought about by slippery floors and stairs is because the people using them constantly have become watchful. The same cause is responsible for lack of attention on the part of the individuals charged with the responsibility for safety.

Off-hand, the job of rendering floors non-slippery doesn't appear so difficult. But, in trying to get right down to doing something, the remedy isn't quickly apparent. What is it, anyway? Or rather, what are they?—because the difference in flooring materials and the variety of things that get on the floors to cause slipperiness call for several remedies.

A Court of Law Passes on the National Electrical Code

THE standing that has been accorded in a court of last resort to the National Electrical Code is told in an interesting case reported in the January, 1930, issue of *Nema News*.

Briefly, the Alabama Power Company had one of its office buildings wired by a local electrical company. Later on, a contractor was hired to wax and polish a floor in the office building. Steel wool and gasoline were used in doing the job and while one of the contractor's men was cleaning around an electric floor connection for operating office appliances, a flash ignited the gasoline and the workman was fatally burned.

In the ensuing trial the Supreme Court of Alabama held that: "The type of floor fixture alleged to have been negligently maintained is shown by the undisputed evidence to be known as an 'Edison base-type receptacle.' The use of this type in floors is forbidden by the National Electrical Code for Interior Wiring. Evidence went to the effect that this Code is the standard, and is used by all competent wiremen *****.

"In connection with such evidence, the Code, being the expression of the matured judgment and experience of men in that business, becomes evidence of correct appliances for such places, and evidence that the use of fixtures forbidden by it is negligence."

The 1930 edition of the Code is now available and may be obtained from the National Fire Protection Association, 85 John Street, New York City. It will behoove those responsible to see that electrical work is executed in accordance with the provisions of this Code, except when permitted by competent authority to do otherwise. Cutting corners by disregarding some of these provisions may be momentarly profitable in time or money, but if a day of reckoning comes it may be found that that small profit has been very dearly bought.

A Resolve for the New Year

THE Psalmist of old, who said in pessimistic vein, "There is nothing new under the sun," may have been correct, but in this iconoclastic age there are plenty of good folks who would heartily disagree with him. After all, the matter of definition has something to do with it.

As we look back over a year it may be difficult to recall any outstanding developments in the older-established branches of engineering and science. A multitude of new devices may have been introduced, but examination frequently shows merely refinements in details, rather than the employment of radically new principles.

This condition must necessarily be true in many cases, but it should not be assumed to apply to all of the many devices that reach the market each year. In this regard, one of the largest electrical manufacturing companies has recently stated that more than 20 per cent of its business last year was in items that were non-existent or had no commercial significance ten years ago.

There is no question that plant men today have many highly-efficient tools and ways of doing things that were virtually unheard of a few years ago. Nevertheless, one does not have to travel far to find many instances where the operating force of a plant has failed to avail itself of the latest and best equipment for important services. Hesitancy to replace equipment so long as it can be kept running, satisfaction with present records and conditions, and sometimes ignorance of the possibilities of equipment now available, all con-

The Maintenance Engineer Is the Man of the Hour

tribute toward keeping in service equipment that should have been discarded long since.

Any plant engineer who is not already doing so may well resolve to watch closely during the present year all developments in equipment of interest to him, to become thoroughly familiar with the latest methods and equipment, and to utilize that knowledge to effect improvements and economies wherever possible. And *now* is the time to give serious attention to plant betterment, replacement of equipment, revision of housekeeping standards.

Jobs for "Assistant Executives"

"MILLIONS of dollars are being wasted annually by American manufacturers through their inability to keep informed about the machinery and equipment in existence in industries other than their own." The quotation is from a statement by G. Vallee Bain, of MacDonald Bros., Inc., production engineers.

Mr. Bain points out that much money is spent on research work and the development of special machinery when, very often, that machinery is already in existence in another industry. He goes on to say that the cause for this waste is the lack of a central place where a factory executive may go to view machinery and equipment in use in other industries, or where he may obtain information about them.

There are many difficulties in the way of having a central place such as he refers to. Whether or not it would be practicable in the long run, certain it is that his conclusions in regard to money wasted are correct. Perhaps, however, his choice of the word "inability" was not the most fortunate. Executives do not take full advantage of existing opportunities for keeping well informed. They do not travel into their own industries as much as they should, to say nothing of other industries. And they do not read as faithfully as might be the literature of methods and equipment brought to their desks by their industry, technical and business publications.

Of course executives are busy, and can't do everything themselves. But they have assistants, from secretaries right down through the foremen in the plant. By delegating to these assistants part of the duties of plant visiting and reading they can reduce that "inability" appreciably.

Assistant executives are important units in the industrial structure. If started along the right track, and encouraged to be progressive, they will find many methods of getting and giving information. They will soon realize that the success of the nation as a whole depends upon the widest dissemination of the information of processes and equipment; will contribute to the programs of technical and other societies; will take renewed interest in technical literature; and will become acquainted with many other assistant executives who will be of sundry and appreciable help to them.

Let There Be Enough Light

FEW subjects of interest to plant men have been given so much attention as artificial lighting has received during the past few years. Out of the volumes of information that have been published there has come a guilty feeling on the part of most users of light that they are not using enough of it.

At a recent meeting of the New York section of the A.I.E.E. in the Westinghouse Institute of Light, some interesting facts were disclosed that enable us to determine how far our present practices fall short of meeting ideal conditions. It was shown, for example, that the present minimum of "good practice" in the illumination of ordinary work is 15 foot-candles, whereas the minimum recommended level is 30 foot-candles. On the other hand, it is considered that 50 foot-candles represent the probable level of greatest economic advantage, and the possible desirable level, from the standpoint of the eye alone, is placed at 300 foot-candles.

Probably no one knows the ideal level for best vision; it can safely be said to be not under 30, and probably is more than 100 foot-candles. These assumptions seem to be conservative enough when it is considered that full sunlight averages about 10,000 foot-candles, and that the human eye was developed and probably did its first close work at levels of illumination that extended from well above 100 up to around 1,500 foot-candles.

What levels of illumination good practice will require five or ten years from now can only be guessed at, but there is every reason to believe that the tendency for some time to come will be to use higher and higher levels for general illumination of all work places.

In the meantime, wise planning of new plants, and additions to old ones will dictate the provision of ample facilities, including feeders of generous capacity, for furnishing intensities that are practically certain to be considered higher than those deemed adequate at present.

Clutch Speed and Power—Discussion

ON page 494 in the October issue of INDUSTRIAL ENGINEERING there appeared a brief item under the above heading to the effect "that the torque rating for a clutch is materially reduced as the speed increases," and on which H. L. Unland, Riverton, N. J., comments as follows:

"This is a rather startling generality and I believe that the author could make an interesting amplification of this point.

"For magnetic clutches of a well-known type, extensively used, the horsepower is based on the unit horsepower per 100 r.p.m. It is rather difficult to see wherein centrifugal force would decrease the torque transmitting quality of such a clutch. To go to the other end of the scale, the simple jaw clutch will hardly have its torque transmitting quality reduced by an increase in speed.

"There are certain types of centrifugal starting clutches for starting centrifugal extractors in which the torque naturally increases with the speed."

In amplifying the point in question, reference is made to a paragraph on page 227 of my book, "Mechanical Power Transmission," which reads:

"Speed of Clutches (r.p.m.)—The speed in r.p.m. is the second important factor to be considered because the horsepower transmitted does not increase in direct proportion to the speed increase except in the case of a clutch used as a safety coupling and which is operated only at rare intervals."

You will note that I say the horsepower transmitted does not increase in direct proportion to the speed increase except in the case of a clutch used as a safety coupling and which is operated only at rare intervals.

Horsepower and torque are almost synonymous when referring to motors, and are synonymous when referring to clutches; therefore my statement is absolutely correct because, regardless of the design of a friction clutch, high speed is conducive to slippage. All clutch manufacturers take this into consideration when rating their clutches. If you will refer to the table given in this book on pages 232 and 233, you will note, for example, in Col. I of the table, the figure 1 at 100 r.p.m. If we have a clutch that is to transmit 10 hp. at 100 r.p.m., we multiply 10 by 1 and the answer is 10 hp. If it is desired to step this same clutch up to 400 r.p.m., consult Col. I at 400 r.p.m. and find the factor 3.08; therefore, $10 \times 3.08 = 30.8$ hp. instead of $4 \times 10 = 40$, based on 10 hp. at 100 revolutions per minute.

The first column is for use only when the load is steady, the clutch is allowed the normal 6 to 8 sec. to pick up this load, and the starting load is light as on ordinary lineshafts.

The second column allows an overload of 25 per cent and is used where the load is on at the start, otherwise the same as mentioned heretofore.

The third column allows an overload of 50 per cent and is used when the load is heavy and started from rest, when there are shock or reversal conditions.

The fourth column allows an overload of 100 per cent and is used where there is a combination of jerky power, widely-fluctuating loads, and poor operating conditions.

A clutch may be operated once every two hours, or four times per day, without causing any excessive wear; but when this number is to be exceeded, 2 per cent should be added to the required horsepower for each engagement per hour over the maximum allowable frequency of operation.

In reference to the jaw clutches, they cannot be considered in the statement because a clutch of this character should not be employed as a connection to drive apparatus at speeds in excess of 60 revolutions per minute.

WM. STANIAR

Electric Heat—Discussion

IN your editorial, "Electric Heat Belongs in the Modernized Program," I note your reasons for prefering electric heat to that of fuels. In my experience on a number of furnaces that have been operated with both gas and electricity we have been able to obtain a straighter line on the chart of our recording pyrometer with gas than with electricity. This is due to the fact that there are control valves on the market of a floating type, which maintain a constant firing condition with just a slight progressive change as the pyrometer calls for more or less heat. The old types of control valves were on and off, so that a very wavy line was obtained, but with the new type valves very gradual changes are obtained and it is possible to make a line so straight that I have often wondered whether the control equipment was functioning. With electricity, the cutting in and out of banks of resistance always gives me a wavy line.

We have just recently changed over a number of electric ovens to gas-firing. In one plant, the use of indirect gas-fired recirculating air heaters has not only eliminated hazards, but the fire underwriters have actually recommended that special fire-fighting equipment hitherto required on electric and gas ovens be dispensed with and the insurance rates have been lowered. At present, electric ovens still require these protections. This firm claims that the quality of its work is superior with gas heat than with electricity.

In light of the very rapid progress made in heating equipment, it usually is not so much the fuel, but the method in which it is applied, as well as the knowledge and intelligence of the designer, that determines the advantages of the heating medium.

F. M. REITER

Maintain Buildings Systematically

OUR business in the Orient has made it necessary for me to make several trips to Japan and China. I once remarked to a friend about the wretched condition of many buildings of impressive design and substantial construction.

My friend replied, "A Chinese never touches a building to repair it until it has stood twenty years. This is true even though the roof falls in."

Some concerns of my acquaintance seem to think that, like the Chinese, they can build an expensive building and then forget it. They let it go for long periods without paint and seldom or never wash the windows. In a few years a property that should still look like new, has the appearance of an antique. Such neglect is extremely expensive.

Well managed plants are constantly inspected for signs of wear or deterioration and are always kept in first class physical condition. The effect of a clean, well kept plant upon the morale of the workmen may be worth the cost of a well organized maintenance program.

JOSEPH S. RUBLE
In *Ferguson Cross Section*

• QUESTIONS •

Asked and Answered by READERS

Desirable Width of Aisles and Spacing Between Benches

A question has come up regarding the minimum desirable or safe width of aisles in factories, and the minimum space between workbenches where employees work back to back. We are interested in the problem from the standpoint of accident prevention, particularly where every effort is being made to increase production, and floor space is limited.

I should like to know whether readers have any spacing standards covering these points, with the limits that have been found desirable.

Philadelphia, Pa. R. J. F.

Heating of Coil Clamp in Magnetic Brake

On a crane in our plant one of the brakes is of the magnetic-release type and consists of two coils in series, connected across one phase of the 220-volt, three-phase motor. One coil is placed over each end of the U-shaped polepiece of the brake, and the coils are held down by an oblong, cast-iron clamp. This clamp becomes very hot, although some others of the same design do not. Why is this?

I have adjusted the plunger to the recommended stroke, and it works freely. The shading coils in the polepiece seem to be in good condition. The brass cores on which the coils are wound were separated from the top and bottom clamps by strips of fiber, but the top ring would become so hot as to burn these strips, although the bottom ring did not. I have tried leaving these strips out, but with no better success. I tried using two straight straps as clamps, but the coils burned out then. If others have had this trouble, I should like to know how they solved it.

Lawrence, Mass. L. A. T.

How Can Surge Be Taken Out of Conveyor Chains?

I would like to hear from some of the readers as to what they are doing to take the jump or surge out of their conveyors.

There are five conveyors in the plant I am responsible for and they all surge to a greater or less degree. In the shorter ones this amounts to so little that it does no particular harm, but in the longer ones which are heavily loaded it seems to rock the whole structure and must be putting a heavy strain on it, which will sooner or later cause a failure.

We had motor readings taken and the motors are not overloaded, and the tachometer reading shows no fluctuation in the speed. We have further checked the entire conveyor and the chain is not catching at any point. If anyone has licked this problem I would appreciate knowing how it was done.

Birmingham, Mich. F. G. L.

Effect of Starting 500-hp. Motor Across the Line

I should like to know the probable voltage drop, and the effect on our generating equipment caused by starting across the line a 2,300-volt, 500-hp., 60-cycle, three-phase, 600-r.p.m. squirrel-cage induction motor direct-connected to a blower fan. Assume that the load on the generators is (1), 75 per cent and (2) 100 per cent.

Our generating capacity is 20,000 kw. The voltage regulators are quick response, as are the exciters, and the generators have good inherent regulation. If installed, the 500-hp. motor will be located not more than 100 ft. from the generator bus.

Would it be advisable to start this motor by throwing it across the line, under the above circumstances?

Hamilton, Ohio H. B.

Limiting Factors for Crossed-Belt Drives

Rearrangements planned for some of our departments will necessitate the use of a number of crossed-belt drives. These belts range from 3 in. to 10 in. in width and according to present plans will have to run on center distances varying from 10 ft. for the smaller belts to a maximum of 23 ft. for the larger ones. I want to avoid trouble with these drives and wish some reader would give me formulas or limits that I can safely use for (1) maximum width of belt that can be crossed, (2) minimum and maximum center distances and (3) maximum pulley ratios.

Brooklyn, N. Y. J. C. O.

Checking Polarity and Ratio of Instrument Transformers

Will some reader please tell me how to check the polarity of potential and current transformers used with meters and other instruments? Also, is there any way to check the ratio of current transformers by the use of two single-phase watt-hour meters?

Girvin, Texas. C. W. F.

Using Rubber Hose in Place of Conduit

In our plant we have used several thousand feet of rubber hose, in place of conduit. While the basement walls and engine blocks were being built the hose was laid in the concrete. All necessary wires were pulled into the hose before it was put down.

I wonder if any of our readers have tried this scheme, or can tell me whether this installation will be satisfactory. How long should the rubber hose last? Will it tend to draw moisture?

Palmer, Neb. J. M.

Voltage Will Not Build Up on Generator

A puzzling case of trouble has developed on a 35-kw., 115-volt, compound-wound, d.c. generator. The commutator bars became loose and the armature was sent out for repairs, although the generator ran satisfactorily except for considerable sparking during heavy loads, and rapid wear of the brushes.

When the generator was reassembled after repairs had been made we checked all connections, but the voltage failed to build up. On the possibility that the fields had lost their magnetism, we charged them with a 6-volt battery, without result. By exciting from an outside source we are able to light only two 60-watt lamps. Will someone kindly tell me the probable cause of our trouble and how to locate it?

Huron, S. D. B. H.

ANSWERS *to* QUESTIONS

What Is Wrong in This Fuel Oil System?

We have been experiencing a considerable amount of trouble with the plugging up of the oil burners on our oven heaters. I traced this trouble back to the time we started using a heavier grade of fuel oil. Before putting the heavy oil into our tanks we tried some of it in drums, feeding it to the burners by gravity and no trouble developed during a 30-day trial. However, since we got it in tank car lots we have been bothered with it settling out in the pipe lines in the form of tar. We have tried heating it to a higher temperature which seems to make the condition worse. I would appreciate it if someone would tell me what causes our trouble and how to overcome it.
Detroit, Mich. R. D. L.

ANSWERING R. D. L., in order that a fuel oil system may operate properly, it is necessary that a return line be provided so that there will be a continuous flow of oil through the system and back to the tank. A bypass or pressure regulating valve must be provided, of course, in the return line to maintain the desired oil pressure. If the return line is not provided, the tar-like substance mentioned, and also small hard particles, collect in the pipe and stop up the flow of oil at the needle valves.

Another cause of trouble is the collection of dirt in the bottom of the tank. When the tank is nearly empty, the continuous flow of oil from the return line to the bottom of the suction pipe carries more dirt with it than when the tank is more nearly full. The tank should be cleaned out at least once a year.

Oil of 14 to 16 gravity can be used very well in the warmer months. However, during the winter, oil of 18 to 20 gravity will give better satisfaction on account of the difficulty of handling the lower gravity oil when cold. In any case, heating the oil to 150 deg. F. improves the combustion.

THEO. F. H. ZEALAND.
Works Engineer,
Maremont Manufacturing Company,
Chicago, Ill.

THE direct answer to R. D. L's question is: There is nothing wrong with the system, except that it is incomplete. Nothing has been put into or made a part of the system to take care of the oil sludge that separates and goes to the bottom of the storage tank.

Until about five years ago the oils on the market were of relatively high gravity and low viscosity. The percentage of carbon and other precipitate was very small and, of course, there was no problem of sedimentation. Fuel oils today are largely the product of the high-temperature cracking process, and the gravities run low, wherever the viscosities are high. In these oils we find a higher percentage of free carbon and when the oil is held in a storage tank without agitation, the force of gravity tends to separate the heavier from the lighter portions and bring them to the bottom. There is nothing new about this, as it is a simple, physical process.

Now, when the oils are heated, the viscosity goes down; in other words, the fluidity is increased and the resistance to sedimentation or separation grows less. In fact, the best way to make a separation of the free carbon from the lighter oil portions is to heat the oil hot enough to reduce the viscosity, when the force of gravity will do the rest. This is what we might call the disease; the cure is as follows:

Put in a mechanical stirring device to agitate the tank, or use compressed air. The tank can be piped up for the compressed air treatment and a good distribution is accomplished by drilling a number of small holes in the air pipe. If this is not feasible, simply take a piece of ½-in. wrought-iron pipe and fasten it to the air hose and with this as a nozzle agitate the oil and sludge thoroughly throughout the tank.

If the process stopped here, it would mean all kinds of trouble from valves and burners clogging; so the oil needs to be mechanically treated to where the sludge particles are ground, milled, and mixed so as to form a homogeneous mixture.

There is a machine on the market for this purpose. It was designed and developed to overcome the troubles described by the questioner.

ROBERT C. HOPKINS.
The Volcanic Specialties Company,
Alliance, Ohio

Will This Machine Have to Be Rewound?

We have a Westinghouse Type HS motor, wound for operation at 550 volts, three phase, 60 cycles, 490 r.p.m. The winding has a total of 144 coils and 144 slots; the grouping is three and four coils per group. The coils lie in slots 1 and 7 and the winding is connected two-parallel star. Can this winding be reconnected for 440 volts, 570 r.p.m., three phase, 60 cycles. If so, what changes will have to be made, and what will be the horsepower developed under the new conditions?
Chicago, Ill. A.A.

THE present winding in A. A.'s motor is arranged to give fourteen poles. It can not be reconnected for operation at 440 volts, twelve poles, to give a speed of 570 r.p.m., as the chord factor would prevent proper voltage relations.

The motor should be rewound, using the same number of turns and size of wire as in the present coils. Change the coil pitch to 1-and-10, and connect three-parallel star, grouping four coils in series. At the new speed, about 290 hp. will be developed.

Wilkinsburg, Pa. A. C. ROE.

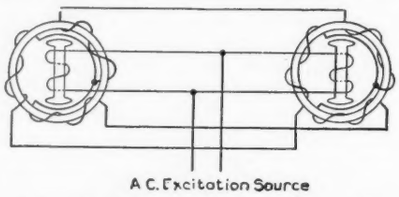
Using Wattmeter to Measure Reactive Kva.

1. Will someone tell me whether an ordinary wattmeter can be used to register the reactive kva. in a circuit? If so, how should it be connected?
2. Some time ago I saw a description of an electrical method of connecting together two polyphase motors so that when one of the rotors is turned a portion of a revolution the other rotor will turn likewise. I shall appreciate any information you can give me regarding this arrangement.
Philadelphia, Pa. L. S.

THE answer to the second part of L. S.'s question is that this arrangement is possible, but not with ordinary squirrel-cage or slipring motors. Devices that produce this effect are now on the market and are finding an extensive variety of uses.

These units are in some respects similar to three-phase induction motors, but have shuttle-wound rotors with definite poles whose windings are connected through sliprings to a single-phase, alternating-current source of excitation.

The motor and indicator are essentially the same, the one running as a motor when a force is applied to the other as a generator. The rotors of



Connection between two motors of special type, so arranged that when the rotor of one is moved by an external force, the other rotor will move a corresponding distance in the same direction.

both the transmitter and the indicator, as they are sometimes called, are connected to the same supply circuit and their stators are connected together, as shown in the accompanying schematic diagram of connections.

Dayton, Ohio. RALPH F. EHLER.

ANSWERING L. S., an ordinary wattmeter can be used to register the reactive kva. in a circuit by connecting it as shown in the diagram.

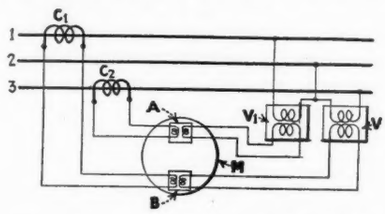
Lines *1, 2* and *3* indicate the conductors of a three-phase circuit; *C* and C_2 indicate current transformers; V_1 and V_2 indicate voltage or potential transformers; *M* indicates a wattmeter of the polyphase type, the general connections being the same for an indicating wattmeter or watt-hour meter, or for single-phase meters. *A* and *B* are the separate elements in the meter. The meter will give an indication which must be multiplied by the constant $\sqrt{3} \div 2$ or 0.866 to give the true reactive kva. The writer has actually

ANSWERS *to* QUESTIONS

used this arrangement for both indicating and rotating meters with good results.

Its use makes it unnecessary to purchase special potential transformers so that the reading will be direct. It will be noted from the diagram that the only difference in the connections is that the current elements of the meter operate in conjunction with the voltage from the neutral to the other line, instead of from the neutral to the same line to which the current transformer feeding the meter element is connected.

The second question by L. S. evidently refers to what is usually called a position indicator or a Selsyn device. The names given are those used by two



Connections of wattmeter for indicating reactive kva. in a three-phase circuit.

vendors who offer these devices. The general features of operation are the same and the device consists of two elements located at points remote from each other. Each element is essentially an induction motor, one station being the sending end and the other the receiving end. The single-phase portions of the element are continuously excited from the same power system, or from lines that have the same time-phase relation.

The three-phase parts of the elements at each station are connected together by an intervening circuit. If the rotor of the sending element is moved the rotor of the other or receiving element will move at the same speed and in the same direction. There are many possibilities for applying these devices.

C. O. VON DANNENBERG.

New York, N. Y.

REPLYING to L. S., if a wattmeter or watt-hour meter is connected to shift its potential 90 deg. from the normal relation the meter will measure the reactive component.

For single-phase circuits a standard, single-phase wattmeter may be used in which a condenser and ohmic resistance are connected in series with the potential circuit, diagram *A*, shifting the flux due to the potential coil 90 deg. The accuracy of this method of compensation is dependent absolutely on frequency; any variation of the frequency will affect the accuracy of the registration.

A method of measuring reactive

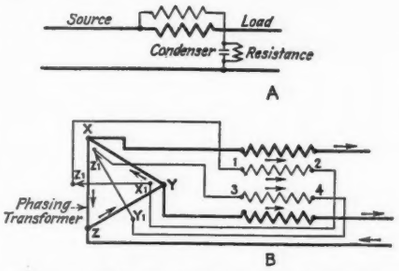


Diagram A shows the connections for measuring reactive kva. in single-phase circuits, using condenser and resistance in potential circuit of meter. In B is shown a method of measuring reactive kva. in three-phase circuits, using phasing transformer and ordinary two-element meter.

kilovolt-amperes in a three-phase circuit is shown in diagram *B*. A standard, two-element polyphase wattmeter is used, having the potentials displaced by a phasing transformer 90 electrical degrees from those used in measuring kilowatts. In practice, the phase rotation may be in either direction. The connections indicated in this diagram may be such that the meter will rotate or indicate backwards; then it will be necessary to interchange the connections at *1* and *2* and those at *3* and *4*. There are various means by which potentials of the proper phase relation may be obtained, but the most common involve the use of an auxiliary reactor, or a phasing transformer.

PHIL D. CONNER.

Huntington Park, Calif.

What Is a Good Floor Cleaner?

We have lately laid down some hard block floor inside of our plant. As yet we have found no satisfactory method of cleaning it as dirt and oil seem to be building up on this section of the floor. At present we are using scrapers but this requires a considerable amount of labor, and I believe it does the floor no particular good. I would be pleased to hear from anyone who has a satisfactory solution for cleaning this type of floor.

Oak Park, Ill. M. M. H.

UNDOUBTEDLY M. M. H. would find a mechanical scrubber, of which there are several makes now on the market, a great aid in removing the grease and dirt from his block flooring.

A good practice to follow in using a scrubber is to scrub the floor once or twice a week with hot water and some strong cleaning agent. Between scrubbings keep the floor as clean as possible with ordinary brooms or brushes.

Perhaps M. M. H. would find it a good plan to take another step forward and arrange to keep the grease from getting on the floor. For example, he might find it possible to localize all of the dirty, greasy processes on one small section of the floor, or arrange to protect it in some way at these places.

Denver, Colo. CARL A. WAGNER.

Laying New Cement Surface on Old Foundation

About four years ago we put in a number of outside concrete ramps, sidewalks and runways between buildings. For the past year the finished surface of much of this concrete work has been cracking and coming loose from the base, which appears to be the usual crushed stone and cement mixture and is standing up well. Some of the runways have been subjected to fairly hard service from electric and hand trucks, but on the sidewalks and in other places the traffic has been light, although cracking of the surface is about as severe here as elsewhere. I should like to know (1) what has caused the trouble. (2) As the foundation has a rough surface and seems to be in good condition, would it be advisable to lay a new surface over it? That is, would the new surface adhere to the foundation strongly enough to stand an ordinary amount of usage?

Detroit, Mich. J. C. R.

IN answer to J. C. R., the separation of the finished surface from the body of any cement work can usually be attributed to (1) allowing the foundation to set too much before surfacing; (2) internal strains due to the ground on which the cement is poured not being rammed enough; (3) strains caused by low temperatures and sudden changes to high temperatures for which no compensation has been allowed for when the work was laid; (4) insufficient agitation of the materials when mixed.

The remedy for each is obviously possible only when the work is laid originally.

I certainly would not have enough confidence in foundations that have lost their surfaces in large chunks to go to the expense of patching a new surface on them.

Denver, Colo. CARL A. WAGNER.

REFERRING to J. C. R.'s question, apparently his sidewalks and runways were laid with a granolithic finish and this is cracking off, due to weathering. Some contractors persist in this practice rather than take the trouble to level up their guides and finish the work integral with the slab at the start, which makes by far the most durable job.

The standard prescription in cases such as this is to clean off all loose chips, dirt, grease, etc., wash the surface with dilute muriatic acid, then thoroughly with water and refinish with a strong grout, which will be much better if it contains about 50 per cent of flint pebbles about the size of small peas.

We have found that some of the proprietary liquid integral hardeners seem to improve both the sticking and wearing qualities of repairs such as this. H. D. FISHER.

Plant Engineer,
New Haven Pulp & Board Company,
New Haven, Conn.

Flexible Couplings

By WILLIAM STANIAR

Mechanical Power Engineer
E. I. du Pont de Nemours & Company, Wilmington, Del.

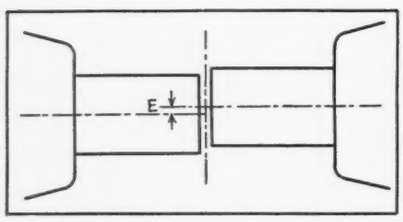


Fig. 1—These shafts are parallel, but out of center.

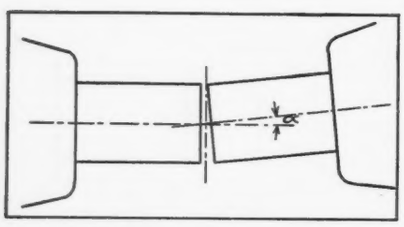


Fig. 2—When shafts are in center, but out of line.

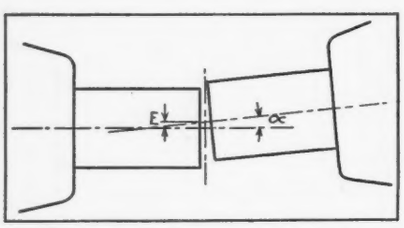


Fig. 3—Here the shafts are both out of line and out of center.

PERMANENT and perfect alignment of one piece of machinery connected to another is known to all engineers and plant men to be impossible. Foundations settle, bolts are drawn up unequally, variations of temperature exist, vibration occurs, and a host of other causes prevent such perfection. Therefore, to avoid bending stresses in shafting and excessive pressures on bearings caused by misalignment there have been devised various types of special couplings. Such couplings are usually spoken of as flexible couplings, although the term "self-alignment couplings" would be more suitable.

The rigid coupling, extensively employed in the transmission of power is, as its name implies, a non-flexible connection; therefore, in many instances it is the direct cause of high maintenance on transmission equipment. It is impracticable to use anything but the rigid coupling on line-, counter-, or jackshafting. However, in the case of direct connection of a motor or any type of prime mover to a machine, reduction gear, or variable-speed mechanism, and the connection of a reduction gear or variable-speed mechanism to apparatus, the coupling should be of the flexible or self-aligning type because of the instability of supporting mediums.

Stress due to misalignment of shafting is very common, as bearing alignment is rarely perfect at the time of installation and still more rarely remains perfect. Not only are severe stresses set up in the transmission lines, but the bearings are unduly loaded in a manner that is often difficult to determine but which bears a direct relation to the degree of misalignment.

Misalignment of power transmission mediums caused by uncontrollable structural conditions can be resolved into two essentials which govern the design and requirements of flexible couplings: First, to transmit power from one shaft to another when such shafts are not in perfect axial alignment without imposing loads on the shafts and their bearings other than those due to torque. Second, to permit free lateral movement or lateral independence of one shaft relative to the other.

According to an authority on flexible couplings, "The first condition is unattainable where the shafts are misaligned, because a pure torque can be transmitted only from one shaft to another where the shafts are in perfect axial alignment. The second condition can readily be attained where the shafts are misaligned. * * *" Misalignment of two shafts connected endwise can be classified into two distinct forms, and a third which is a combination of the other two.

The first is known as "parallel misalignment," wherein the shafts are parallel, but out of center, as shown by Fig. 1. The second is known as "angular misalignment," wherein the shafts are in center, but out of line, as shown by Fig. 2. The third, comprising the first two inaccuracies, is known as "shafts out of line," and also "shafts out of center," as shown by Fig. 3. The latter is the one generally met in actual practice; therefore a self-aligning coupling is essential and should be designed to meet this condition.

At times the combination of errors is small, but as a rule the speed is high in such cases; where the errors are relatively large the speed generally is low, which is fortunate for both the coupling manufacturer and the user.

There are two general classes of flexible couplings manufactured: namely, "single engagement," and "double engagement." In the former,

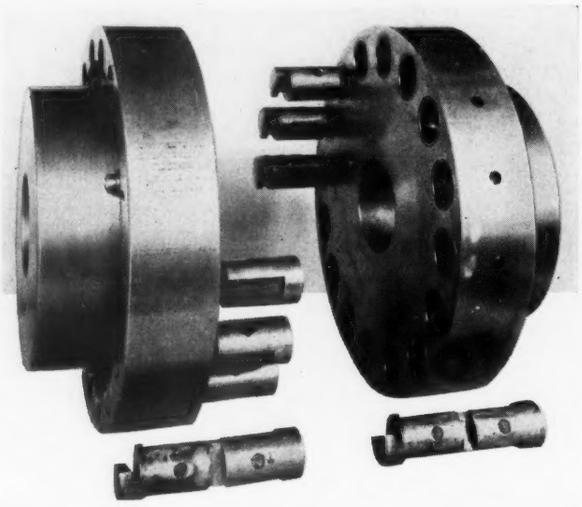


Fig. 4—A laminated, steel-pin unit is the flexible medium in this coupling.

reverse bending in the shaft is avoided by inserting flexible connecting parts, such as rubber, leather, fiber, or thin steel. Such elements allow a certain amount of bending action in the coupling by their ability to "give" under load.

In the latter type, flexibility is secured by means of sliding members, which is claimed by some authorities to give an advantage in strength and double engagement capacity over the other. The underlying principle of the double-engagement type is to use two single-engagement couplings so arranged that they are subjected only to angular misalignment; in other words, the two conditions of misalignment are translated into one.

The rigidly-bolted, solid-flange coupling is probably the oldest known method of coupling two shafts together. Years ago this type was modified by a basic change in the form of either a flexible pin in place of the rigid bolt, or a flexible bushing around the bolts. These modifications were for the purpose of securing flexibility and were the origin of the various types of modern pin-and-bushing flexible couplings. As with other items of mechanical equipment, the development and refinement of the pin-and-bushing idea has been carried on in different directions by different manufacturers; it is these refinements that have made possible the flexible coupling of this type.

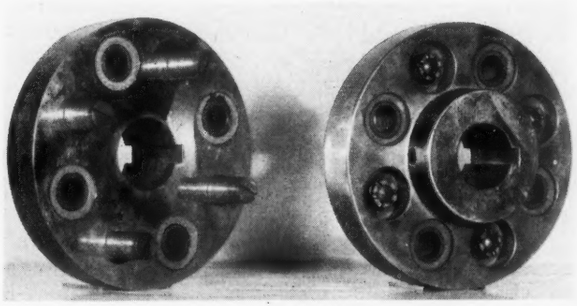


Fig. 5—In this coupling the pin bushings are composed of a special rubber compound.

One of the most modern pin-and-bushing flexible couplings is shown, disassembled, in Fig. 4. This coupling is capable of handling errors of shaft alignment in an angular direction, radially, or out of center, and in an endwise direction. Its flexibility and shock-absorbing qualities are made possible by flexible, laminated-steel pin units which are locked in one flange by a spring retaining ring, and are free to move endwise within bronze or graphited-bronze bushings in the opposite flange.

Where there is any endwise movement or angular misalignment of the connected shafts, the flexible-pin units move endwise within the renewable bronze bushings; thus the wear takes place only between the outside of the pin units and the inside of the bushings.

Inasmuch as rubber is the best shock absorber known — practically all other materials have been discarded for the bushings used in flexible couplings of the pin-and-bushing type—the coupling shown disassembled in Fig. 5 utilizes a special compound of rubber for its pin bushings. The rubber employed in the coupling is compounded against "flow" and premature ageing, to insure a maximum of distortion and the ability to return to its original shape. To prevent friction between the driving pins and the rubber, a graphited-bronze bearing is cemented into the center of the rubber. To limit the load on the rubber to expansion and compression, the rubber and bronze assembly is pressed and cemented into the holes in the flanges. The pins of this coupling are of manganese alloy steel, hardened and ground, and the bronze bushings are impregnated with graphite to provide lubrication.

The shock-absorbing qualities and flexibility of the steel spring have been employed in three forms: laminated, ring and grid.

An efficient coupling using the laminated steel spring feature both for shock absorption and the correction of alignment error is shown in Fig. 6. The driving spokes or laminated springs are arranged at right angles to the shaft and, consequently, cannot develop end thrust. By means of the tapered slot arrangement the area of contact of the driving spokes is automatically increased with the load and maintains an approximately constant pressure per unit of area; thus an increase in load causes the point of spring contact to move inward, cutting down the leverage on the springs, increasing their stiffness, and eliminating whip. With this arrangement no twisting strains are developed.

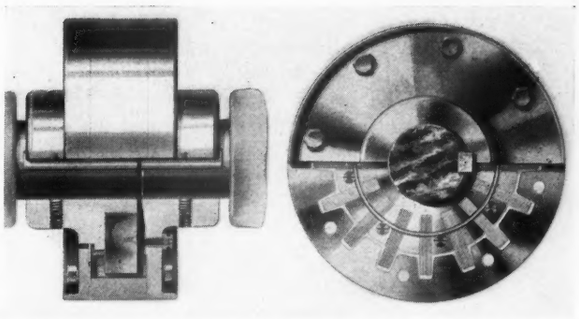


Fig. 6—A coupling using flat, laminated steel springs as the flexible medium.

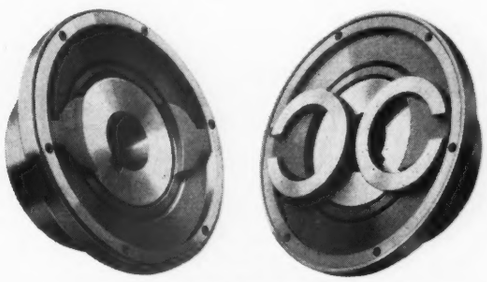


Fig. 7—The ring-shaped steel springs are the flexible medium in this design.

Fig. 8—The flexible medium in this coupling is a circular, grid type of spring.

This coupling is of the inclosed-unit design, which allows internal working parts to operate in either a light grease or a heavy oil. This inclosed unit not only keeps the lubricant in, but also keeps grit and dust out; therefore, it is suitable for use in foundries, cement mills, or when exposed to the weather.

An all-metal coupling employing ring-shaped springs is shown in Fig. 7. It is fully inclosed design of the full-floating, semi-universal-joint type. It approximates the universal joint in so far as it takes care of excessive misalignment. End play is taken care of by the sliding of the hardened surfaces of the sleeves on the driving pins on the hubs.

The shock-absorbing qualities of this coupling are confined to two or more ring-shaped springs located between the two hubs. They are not subjected to any action other than opening and closing under load; therefore, only a minimum of wear can take place. This coupling is so constructed that the outside shell forms a housing that serves the triple purpose of holding the inside parts in correct position, excluding dirt and dust, and acting as a retainer for the lubricant.

A modern coupling of all-metal design, employing as its flexible medium the grid type of spring, is shown in Fig. 8. This coupling possesses three distinct types of flexibility: torsional resiliency, free end float allowance, and the correction of angular and parallel misalignment. It consists of two flanged steel hubs, a special, tempered steel spring forming a complete cylindrical grid, and a steel shell cover that serves as a lubricant retainer.

The grooves on the peripheries of the hubs which receive the spring member widen inward toward each other. This widening is in the form of an arc bearing a definite relation to the thickness of the grid spring bars; thus, when the bars are bent around the radii the stress in the spring member cannot exceed a safe, fixed value, which results in the stress remaining practically constant throughout the entire elastic range of the coupling.

This design of coupling is adaptable to application where terrific peak loads occur and are passed from one machine to the other, because, in addition to free end float and misalignment flexibility, it is also capable of torsional flexibility.

As an example of the power capacities of modern flexible couplings, a coupling of the design shown by Fig. 8 has been built having a rated capacity of 21,000 hp. at 100 r.p.m., and is actually transmitting at 60 r.p.m. a load of 760,000 ft.-lb., in series.

There is a flexible or self-aligning coupling on the market which employs neither pins, bushings, nor springs; in other words, it does not depend upon the resiliency of materials for its flexible qualities. This coupling, as shown by Fig. 9, is of the all-metal, "double-engagement" type, deriving its flexibility from a simple mechanical principle. Two spur gears, one on each shaft end, are completely meshed with the internal gears of a floating sleeve. With this simple design both offset and angular misalignment are easily compensated for, and independent lateral float of the connected shafts is provided for in a greater degree, it is claimed, than ever before possible.

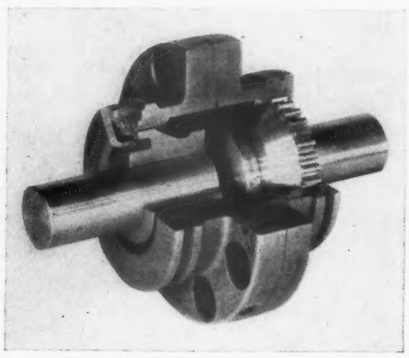


Fig. 9—An all-metal, double-engagement coupling, using internal and external gears with floating sleeve as the flexible medium.

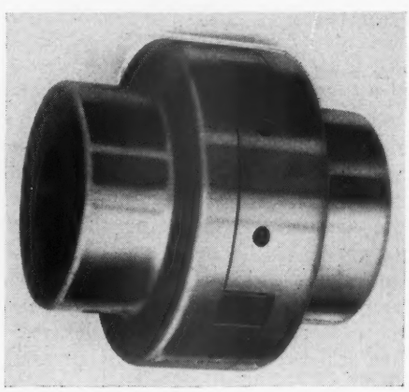


Fig. 10—Two interchangeable jaw flanges with a square floating member between them give this coupling its flexibility.

One of the important features of this coupling is its lubrication. Because of a slight clearance between the external and internal gears, the lubrication facilities create a permanent film of oil between the gear teeth, lubricating the sliding contacts effectively.

One of the most recent designs of flexible coupling which does not depend on the resiliency of material for its flexibility is shown in Fig. 10. This design is based upon the Oldham principle in which a center floating member is constrained to slide across the face of one coupling flange on a line passing through the center, and at the same time is free to slide across the face of the second flange in a direction at right angles to the first.

The coupling consists of two interchangeable jaw flanges and a square, floating member which is a hollow casting with a hole in the center to provide clearance for the shaft ends. To the edges of this floating member are fastened replaceable bearing strips of a hard, tough, non-metallic compound such as is employed in silent gears. The hollow cavity in the floating member acts as a lubricant chamber and is designed to allow the lubricant to pass to the surface of the bearing strips. It is claimed that alignment inaccuracies as high as ¼ in. off center and 4 deg. angular can be corrected with ease.

The lack of flexibility in all classes of mechanical power installations is one of the chief causes of high power losses. Misalignment causes excessive friction which costs real money. Use of flexible couplings whenever practicable is good practice, and good economy.

Reward for Scientific Achievement

AN annual prize of $10,000 accompanied by a gold medal has been created by *Popular Science Monthly* to be awarded the American citizen who has been responsible during the preceding year for the achievement in science of greatest potential value to the world.

The services of twenty-four leaders in American science have been enlisted to serve as a Committee of Award, whose task it will be to select the prize-winning effort.

The prize will be conferred for the first time in September, 1930, and the initial period of scientific accomplishment to be considered by the Committee of Award will be the twelve months ending June 30th, 1930. All scientific workers, professional and amateur, academic and commercial, are eligible.

(Continued from page 86)

With a cutting torch these members can be quickly reduced to pieces readily handled.

Every plant has its piping problems involving sheet metal, standard iron, and steel pipes, where a great saving is often possible by welding nipples, joints, fittings, and so forth.

Although acetylene welding is slower than electric welding, it is indispensable in certain classes of work, when the material is cast iron or thin sheet metal. The electric welder limits its field primarily to steel fabricating jobs.

Acetylene welding requires a more thorough understanding and experience than does electric welding, the dissipated heat of which tends to cause warpage. In an establishment where there is some lead burning to be done it is often good policy to break in a new operator on this work, then advance him to electric and finally to acetylene welding.

The maintenance department's function is to keep the plant running at its highest efficiency, at minimum cost and lost time due to shutdowns. By welding broken parts, production is resumed in the shortest possible time. This unseen item must be considered when balancing the savings against the initial and operating costs of welding outfits. Straight-cut fabricating jobs often can be contracted for to advantage, but it is impractical to rely entirely on outside sources, when it comes to maintenance welding jobs where delays are costly.

A 200-amp. or 300-amp. electric welding machine and one or two standard acetylene tank units will generally take care of repair work and fabricating jobs of medium size in the average plant.

HERBERT L. SCHULTZ, *Asst. Supt. of Maintenance*
Carborundum Company, Niagara Falls, N. Y.

Who Shall Do the Cleaning?

(Question Presented in the August Issue)

ALMOST anything can be done in industry if the proper methods are employed to put the message across to the men. It is my opinion that, fundamentally, by far the great majority of men in industry are constituted with a desire to do right rather than wrong, and that to accomplish an objective result in the methods of doing work it is necessary only to explain in a clear, businesslike manner, the "why" behind the reason and when that is done I have never seen workmen fail to line up with a policy.

There have been, and are yet, many methods for shop cleaning and generally this work is one of the tasks for which the plant engineer is held responsible. A crew of men, and sometimes women, is organized under the leadership of a janitor to do all the cleaning work throughout the plant, and while this has been, and can be, worked out with satisfactory results, yet there are other ways to maintain a clean plant.

It is an accepted fact that men always work better in a clean, orderly shop, and it is well to bear in mind that out of the 24 hours in each day men spend the greater part of the daylight hours in the plant. Therefore we should endeavor to provide for the workmen a clean atmosphere and a clean shop in which to spend those hours.

The problem is not simply one of keeping a shop clean but of keeping it clean at a minimum cost. My own opinion is that each man should keep his own machine and the floor around his own machine clean. When we give serious thought to any shop floor it can be visualized as a small section of floor space for each workman, and if each workman will devote a few minutes of his time each day to keeping his own section of floor clean the problem of keeping the shop clean is answered, except for such large areas as assembly floors, aisles and stairways. If we view an assembly floor as a large area we can readily see that a few moments' time at the close of each day on the part of every workman on the assembly floor would easily clean up that place.

I have in mind a manufacturing plant of some 22 acres of floor space devoted to the manufacture of automobile parts. This floor area was covered with machines arranged in what is known as "progressive manufacture" order. That is, the rough forging or casting was started at one end of a line of machines and was passed from one machine to the next, all along the line, so that when delivered from the last machine the part was a finished, machined part.

For many months this shop was cleaned by departmental sweepers, whose duty it was to keep a certain area swept and to sprinkle sawdust as required, to absorb any oil or water on the floor. We found that this necessitated quite a crew of men, and we also found a distinct indifference on the part of the workmen throughout the plant relative to their throwing bits of waste, pieces of paper, etc., onto the floor instead of into the containers provided.

After making quite a careful study of conditions it was decided to put the responsibility of a clean shop equally upon the shoulders of every man in the shop, and we told the men to recognize the fact that if they did not throw waste and paper onto the floor there would be no such refuse to clean up. We established an order throughout the plant that brooms were to be provided for each line of machines, so that each man could, as found necessary, sweep up under his machine, pick up the refuse and deposit it in the containers.

Sweepers and laborers were provided, whose duty it was to keep all the aisles and stairways swept and to gather up the refuse cans and dump them in a central location. We found this method very satisfactory, and from a standpoint of cost far superior to the previous arrangement.

There was at the outset considerable talk about highly-paid and skilled mechanics using a broom, but that soon died away and as a matter of fact is an argument without foundation. It is well known to all persons in any way associated with manufacturing plants that there is not a man anywhere who is so actively engaged every minute of the day that it is impossible for him to find a few moments in which to do the necessary cleaning of his own floor space and his own machine. This he can do without in any way reducing his productive capacity.

There is another thought in connection with a work-

man's keeping his machine clean that is not often presented. A manufacturer provides the buildings in which are housed many thousands of dollars worth of machinery. A workman, let us assume a skilled mechanic, is employed to operate one of these machines. Now the management places at the disposal of this mechanic an investment of several thousands of dollars. They provide him with a warm, well-lighted and ventilated building in which to work. He is provided with all the conveniences and all the safeguards that are required by the laws of the state in which that industry is located. Compensation insurance is provided for him at the expense of his employer. If by accident, or by his carelessness, he becomes injured he is compensated in cash for that injury.

The employee is paid an agreed price for each and every hour that his record is rung in on the company's clock card, so that he is absolutely certain of his income. (As a matter of fact in a great majority of cases, few men render a full day's work during every day for which they get paid.) The manufacturing company is dependent upon the efforts of the mechanic to so operate the machine that it will continue in service a maximum period of time without repair and at the same time produce such output as will cover all elements of cost that enter into and surround the existence of that machine in operation, and pay the workman his agreed price.

In consideration of all the manufacturer has to do in the way of expense to provide the workman a place to work, is it too much to ask the employee to use a small percentage of his time in keeping this valuable piece of equipment in a clean and workable condition? It is a point of mutual benefit and interest to the employer and the employee.

In conclusion, I say that the cleaning of any plant should generally be the responsibility of the plant engineer, yet the cleaning of departments should be a departmental problem; and the foreman of each department, regardless of whether it be a productive or a non-productive department, should assume responsibility for the condition of his own department.

H. W. Benton, *Plant Engineer*
Pratt & Whitney Company
Member Board of Advisory Engineers
Power Transmission Association

Should the Plant Engineering Department Have the Right to Question Orders?

(Question Presented in the July Issue)

A PREVIOUS answer to this question, appearing in the November issue, voiced the opinion that the location of machinery should be decided by the production or planning department.

My experience in the automotive industry has been under exactly opposite conditions. The plant engineering department has had as one of its foremost tasks the responsibility of making all machinery and equipment layouts. I have seen this plan work very successfully in plants employing from 1,000 to 15,000 men. In these plants the production department has been interested in production schedules, rates, personnel, and quality of product. The planning department makes up the production schedules from sales forecasts and arranges for the supply of all stock.

It is the function of the plant engineer to arrange a plant layout which will fit in with the production schedules and be satisfactory to the production departments.

The plant engineering department is best fitted for this task for the following reasons:

1. A machine layout should be made by a man with technical experience. A modern layout requires the use of many different forms of conveyor systems. The man making the layout should be familiar with the possibilities and limitations of this type of equipment. The specifications for and design of the conveyor systems naturally fall within the province of the plant engineer. He is, therefore, best equipped to make a modern layout.

2. The actual placing and wiring of machinery and equipment will be done by two departments under the plant engineer's control. He is, therefore, in better position to see that the layout is adhered to as approved. The responsibility for a successful layout is thus concentrated in one person.

3. The plant engineer has all the facts relating to permissible floor loads, underwriters' rulings, accessibility of power, steam, air and sewers. He can take these matters into consideration when the layout is made and not have to wait until someone else has completed it before offering suggestions.

4. The machine tools required and the operations to be performed by each are determined by the tool and equipment department. All other equipment, such as conveyors, ovens, and spray booths, is left to the plant engineer. Modern machine tools are readily moved, but ovens and spray booths are more permanently located. The location of this equipment is vitally affected by the rest of the department layout. The plant engineer should, therefore, have the entire responsibility for locating all equipment.

5. The tendency of good management is to strictly separate productive and so-called non-productive activities. They, therefore, limit the production department activities to matters immediately affecting production and group all activities incidental to production under the supervision of other department heads. This has the desirable effect of preventing what might be the otherwise unnoticed growth of non-productive personnel beyond reasonable limits.

6. All revisions in layout of any magnitude, before being approved by the management, are required to be accompanied by a cost estimate. Naturally, the department controlling the actual changing of the layout is in the best position to furnish a good estimate and to see that it is not exceeded.

G. A. Holmes, *Master Mechanic*
Graham Brothers (Division of Chrysler Corp.)
Evansville, Ind.

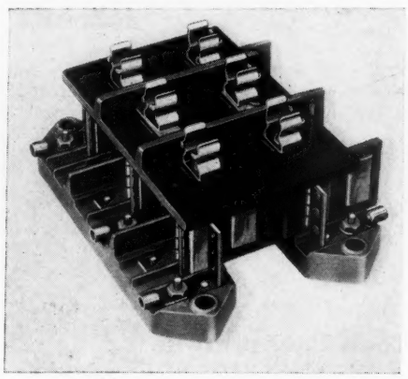
EQUIPMENT NEWS

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices which are designed to improve plant operation or reduce operating and maintenance costs.

Colt Noark "Quadbreak" Switch

IN the "Quadbreak" switch recently introduced by Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn., a very large portion of the applied voltage (at some voltages, the entire applied voltage) is absorbed in arc maintenance. The switch uses such a large percentage of the entire applied voltage because it has four breaks in each leg of the circuit.

The feature of the switch is the switching action, accomplished by two



Colt Noark "Quadbreak" Switch

contacts fastened in an insulating slide which is guided edgewise between two insulating blocks and which moves between two sets of clips. When the switch is thrown to the "On" position, the contacts are moved in between the clips and the current passes through, thus completing the circuit.

When the switch is thrown to the "Off" position the contacts are withdrawn from between the clips and the insulating slide moves between, thereby acting as a constant barrier.

Combined with the sliding switching member and its movable contacts is the lower base for the stationary clips and the fuse block.

C. A. Dunham Company Purchases Dwyer Equipment Company

PURCHASE of the business of the Dwyer Equipment Company, makers of unit heaters, is announced by the C. A. Dunham Company, Chicago, Ill., manufacturers of the differential vacuum system of steam heating and of low pressure steam heating appliances.

The Dwyer plant, now located in Chicago, will be moved to the newly constructed Michigan City factory of the Dunham Company. Certain brass parts will be made at the company's Marshalltown, Iowa, foundry and machined at the company's plant in that city.

Falk Right-Angle Drive Speed Reducers

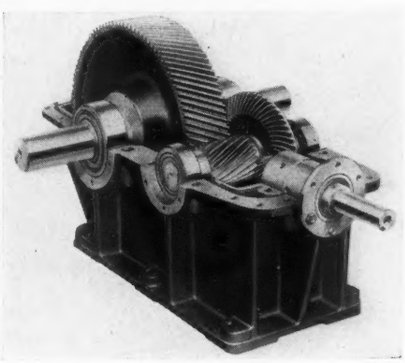
THE Falk Corporation, Milwaukee, Wis., has brought out a line of right-angle drive speed reducers to supplement its line of parallel shaft drives. The line includes both horizontal and vertical shafts. An initial efficiency of over 95 per cent is claimed.

One feature of the drive is a combination of single helical and spiral bevel gears. Another feature is the reversible construction of gears and shafts. If the gears become worn after years of service, shafts can be turned end for end to permit using the opposite and unworn sides of the teeth.

Ratings range from 1/16 hp. per 100 r.p.m. on the smallest unit to 565 hp. at 100 r.p.m. on the largest. Ratios are from 1.5:1 to 518:1.

As in Falk parallel shaft reducers, the lubricating system of the right-angle units is self-contained. A continuous splash system keeps a film of oil on the working faces of gear teeth at all times.

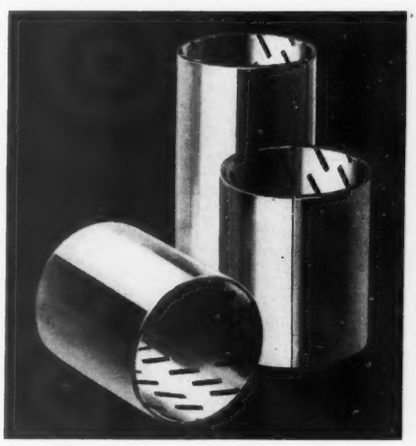
A complete line of welded steel motor beds has been developed to accommodate all motors coming within the capacities of the reducers.



Falk Right-Angle Drive Speed Reducer

Johnson Self-Lubricating Bronze Bearing

A SELF-LUBRICATING bronze bearing has just been announced by the Johnson Bronze Company, New Castle, Pa. According to the manufacturer, the bearing provides for a uniform area of bearing surface on the pressure line, and insures an efficient distribution of lubricating compound. The compound used is a Johnson Bronze development.



Johnson Self-Lubricating Bronze Bearings

Westinghouse Electric Supply System Organized

NINETEEN wholesale electrical supply companies, with branches in sixty cities, have been organized by the Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa., into a single system under the name of the Westinghouse Electric Supply Company.

In this system are the following units: Alpha Electric Company, New York City, and Brooklyn, N. Y.; Commercial Electrical Supply Company, St. Louis, Mo., and Memphis, Tenn.; Commercial Electric Supply Company, Detroit, Grand Rapids, and Flint, Mich.; Electric Appliance Company, Dallas, Houston, Tulsa, San Antonio, Harlingen, Texas, and Oklahoma City, Okla.; Fobes Supply Company, Portland, Ore., and Seattle, Wash.; Fobes Supply Company of Calif., San Francisco and Oakland; Fobes Supply Company of Montana, Butte and Spokane;

Great Northern Electric Appliance Company, St. Paul, Duluth, Minneapolis, Minn., and Fargo, N. Dak.; H. C. Roberts Electric Supply Company, Philadelphia, Pa., and Baltimore, Md., Washington, D. C., Wilmington, Del., Reading, Pa., York, Pa., Allentown, Pa., and Trenton, N. J.; H. C. Roberts Electric Supply Company, Inc., Syracuse, Utica, Albany, and Binghamton, N. Y.; Illinois Electric Company, Chicago, and Peoria, Ill.; Illinois Electric Company of California, Los Angeles, Long Beach, Calif., and Phoenix, Ariz.; Julius Andrae & Sons Company, Milwaukee, and Madison, Wis., and Des Moines, and Mason City, Iowa.; McGraw Division of Julius Andrae & Sons Company, Omaha, Neb., and Sioux City, Iowa.; Newark Electrical Supply Company, Newark, N. J.; Pierce Electric Company, Jacksonville, Tampa, and Miami, Fla.; The Erner Electric Company, Cleveland, Ohio; The F. Bissell Company, Toledo, Ohio; The Varney Electrical Supply Company, Indianapolis, and Evansville, Ind.; Wetmore-Savage Electric Supply Company, Bangor, Me., Providence, R. I., Springfield, Worcester, and Boston, Massachusetts.

Headquarters of the Westinghouse Electric Supply Company are located at 150 Broadway, New York City.

Chicago Pneumatic Grinder and Buffer

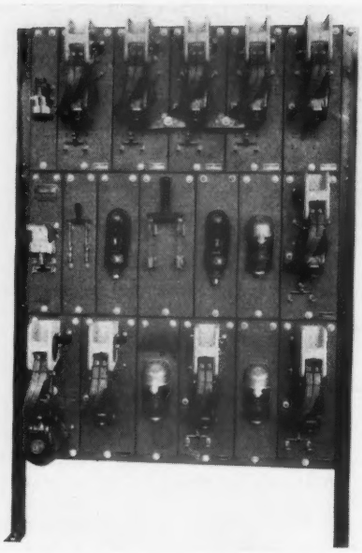
THE Chicago Pneumatic Tool Company, 6 E. 44 St., New York, N. Y., has introduced the No. 10-A "Little Giant" pneumatic grinding and buffing

Chicago Pneumatic Grinding and Buffing Machine

machine for general light work including the smoothing of flush-head rivets, and for beveling and polishing. This grinder is equipped with the closed-type pistol-grip throttle handle as shown in the illustration, but can also be furnished with the straight-type handle. The wheel capacity is 4x¾ in. and the overall length is 16½ inches. It has a no-load speed of 4,400 revolutions per minute.

Electric Controller "Wright" Dynamic Lowering Circuit Controller

A DYNAMIC braking controller for crane hoists is being built by The Electric Controller & Manufacturing Company, Cleveland, Ohio. This unit, known as "The Wright Dynamic Lowering Circuit Controller," is of the magnetic contactor type and is intended



Wright Dynamic Lowering Circuit Controller

for use on crane, ore and coal bridges, and bucket hoists.

With this circuit the brake releases instantly. Instead of passing only one-third of the line current through the brake on the first point lowering, this circuit passes all of the line current through the brake. The operator no longer has to hesitate on the first step; he can move his master controller instantly to any desired speed point. The controller uses EC&M shunt contactors and acceleration relays and is usually supplied with the EC&M Type NT master switch and nickel alloy grid resistors.

Howell Electric Motors Acquires Jeannin Electric

THE Howell Electric Motors Company, Howell, Mich., announces the purchase of Jeannin Electric Company, Toledo, Ohio, manufacturer of a line of single-phase, and d.c. motors from 1/30 to 10 hp. in size.

With the present products, according to the announcement, this purchase gives Howell a complete line of practically all types of motors from the smallest to over 100 hp. in capacity.

Botfield Chromite Cement

BOTFIELD Refractories Company, Swanson and Clymer Sts., Philadelphia, Pa., has developed a high-temperature cement which will be added to its line of Adaproducts and sold under the trade name of "Adachrome" plastic super-cement.

Because of its chromite base, the cement is chemically inert, and is also hard, dense, and highly refractory. It is recommended by its manufacturer for laying up fire-clay brick, silica brick, chrome brick, high-alumina brick, and also magnesite brick under certain conditions. It is adaptable for use as a surface coating material, and as a binder in the mixture of patching materials for repairing burned-out sections of refractory construction.

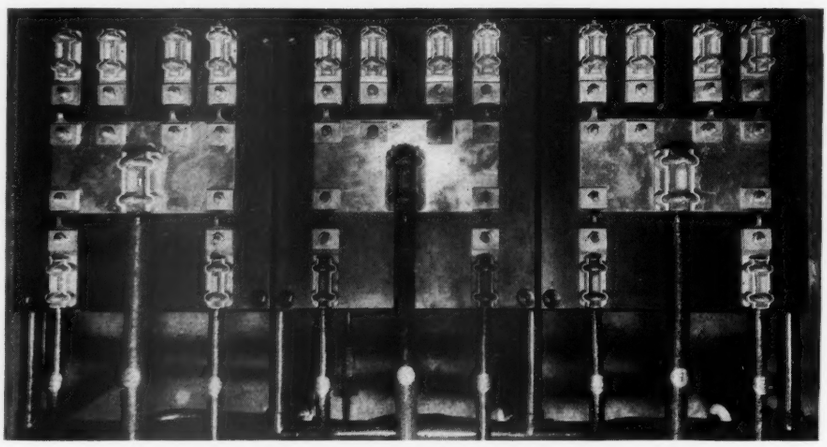
This cement is packed in heavy-gage metal drums with full-size openings. The drums have air-tight covers that prevent waste or deterioration of the material. Two sizes of drums, 250 and 500 lb., are available.

Delta-Star Distribution Panels Equipped with Solderless Connectors

A FEATURE of the distribution panel developed by the Delta-Star Electric Company, 2400 Block Fulton St., Chicago, Ill., for installation in underground vaults is the compression-type solderless terminal connector used.

At the center of the panels are flat copper plates serving as bus bars to which are bolted the connectors with their cables.

Each compression-type solderless connector is provided with a tapered hole. The use of a tapered plug and jumper cable permits easy changing of fuses, testing, or making meter connections.



Delta-Star Distribution Panel Equipped with Compression-type Solderless Connectors

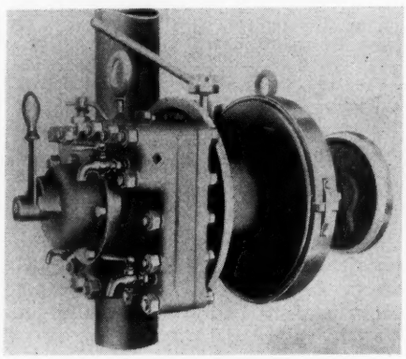
Gardner-Denver Single-Drum Air or Steam Hoists

TWO models of the Leadville single-drum air, or steam hoists, known as Nos. 8 and 10, are being placed on the market by the Gardner-Denver Company, Quincy, Ill. They have greater capacities than the present models Nos. 3, 5, and 6.

The outstanding features of these two hoists, says the manufacturer, are improved engine design with balanced pistons and air control through balanced spool valves with increased port areas throughout.

All moving parts are fully inclosed. Gear sets are inclosed in a dust-proof, oil-tight case. Brakes are of the post type operated with a long lever giving instant application and release. A non-destructive clutch, connecting and disengaging the drum from the gear set, is operated with a lever, and locks in either position.

Crankshafts are of forged ground steel and are run in ball bearings. Model 8 is rated at 6 hp. with a rope pull of 2,000 lb. at a speed of 150 f.p.m.



Gardner-Denver Single-Drum Air or Steam Hoist

The drum is 6 in. in diameter by 9¼ in. wide and has a capacity of 620 ft. of ⅜-in. rope. The weight is 550 pounds.

All gears used in the above hoist are made of steel with cut teeth and are heat treated.

Whitney T-Iron Bench Legs and Benches

T-IRON sections are assembled by riveting and welding to form the bench legs announced by the Whitney Metal Tool Company, Rockford, Ill. As shown, the bench surface is built up by putting a 15x1⅝-in. plank on the leg to support the flooring and absorb the shock. A 5¾x1¾-in. plank is mounted edgewise and securely bolted to the bracket and the leg, and provides a back rest for the flooring. It also acts as a cushion support. Over this is laid ¾-in. hard-maple flooring to provide a serviceable surface for all heavy work. The surface of this flooring is 31½ in. above the floor, providing a convenient height for various operations. The lower cross brace provides

Whitney T-Iron Bench Legs and Benches

a storage space of 19x18 in. for tools and material.

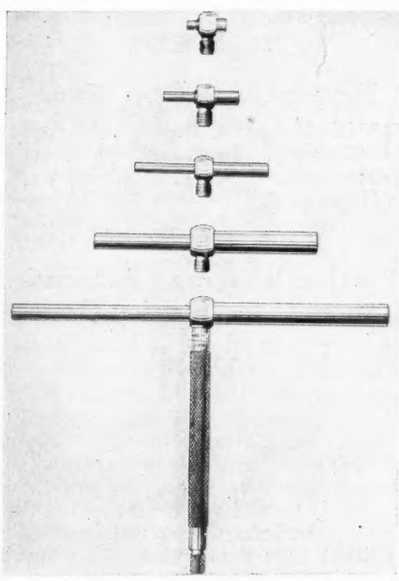
The bench legs are made up into benches obtainable from the manufacturer. All are 31½ in. from the floor and 32 in. wide and are obtainable in lengths from 6 to 16 feet.

Brown & Sharpe Telescoping Gages No. 590

THE Brown & Sharpe Manufacturing Company, Providence, R. I., has recently announced a tool for use with a micrometer to determine internal measurements formerly difficult to obtain.

No. 590 telescoping gages are comprised of five heads interchangeable on one handle. The telescoping head is inserted into the hole or slot to be measured where it expands to the exact size of the hole. A turn of the knurled screw on the end of the handle locks the head and the gage is then removed and measured with a micrometer.

Each head is a self-contained unit. Measuring surfaces of the heads are ground on a radius, adapting the tool for use in measuring curved surfaces.



Brown & Sharpe Telescoping Gage No. 590

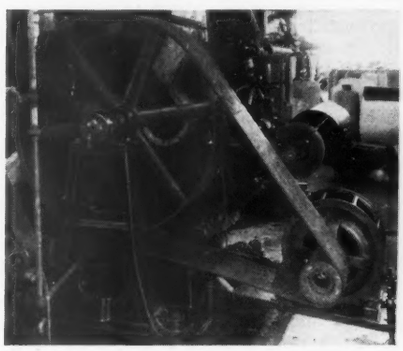
Link-Belt Arrangements for Distribution

THE Link-Belt Company, with executive offices at 910 South Michigan Ave., Chicago, Ill., has inaugurated a plan for carrying roller chain drives in stock at various distribution points throughout the country.

Slip-Not Leather Belt for Short Centers

"TAK-HOLD" is a flat leather belt manufactured by the Slip-Not Belting Corporation, Kingsport, Tenn., and designed to be used on short center drives with standard flat pulleys without the use of idlers or tighteners of any sort.

In construction, the belt consists almost entirely of leather and contains no metal or fasteners of any sort. It is made with a specially designed center which serves at once as a cushion and as a muffler. According to the announcement, the cushion makes the vacuum pull highly effective and the treatment of the cushion muffles any



Slip-Not "Tak-Hold" Leather Belt

whistle or unpleasant sound produced by the belt.

According to the manufacturer no special pulleys or sheaves are necessary, and the belt will not injure a paper motor pulley.

Hammond Electric Polishing and Buffing Lathe

MARKETING of the Type C Rite-Speed electric polishing and buffing lathe for use on alternating current has been announced by the Hammond Machinery Builders, Inc., Kalamazoo, Michigan.

A variety of working speeds are obtainable with this unit by changing the pulley on the motor. Power is transmitted to the spindle by means of a multi-V-belt drive. Other features of this model are: Reduced amount of floor space necessary because the motor is mounted at the rear and outside of the pedestal; belt tension adjustment without disturbing the motor mounting; totally inclosed motor fitted with an air cleaner which discharges dust and dirt before it enters the windings;

Hammond Type C Electric Polishing and Buffing Lathe

belts can be changed easily by removing four cap screws on each side of the spindle which then can be removed without disturbing the bearing mounting or sub-assembly parts; combination switch and brake.

Either tapered roller or ball bearings, automatic motor starter, flat-top threads, and spindle lock are standard equipment. The lathe can be furnished in a range of sizes from 3- to 15-hp. capacity.

Westinghouse Outdoor Apparatus Insulators

WESTINGHOUSE Electric and Manufacturing Company, East Pittsburgh, Pa., announces the listing of a complete assortment of outdoor apparatus insulators. Two types make up the line, a standard-duty type for ordinary use, and a heavy-duty unit for applications requiring higher mechanical strength.

These insulators follow the design of the Faradoid and suspension types and are manufactured under the same specifications. Sanded surfaces are applied to the porcelain and all surfaces of porcelain and metal parts in contact with cement are covered with a resilient material.

Caps and pins are machined before being assembled with the porcelain and

Westinghouse Outdoor Apparatus Insulator

are galvanized by the hot dip process.

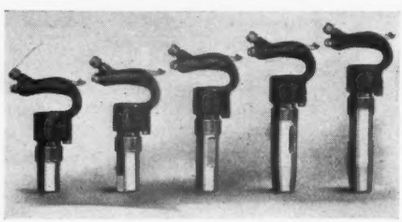
The insulators may be mounted either by pin or suspended from above by the cap, or they may be installed in a horizontal position or at angles as the conditions may require.

Ingersoll-Rand Pneumatic Chipping Hammers

THE Ingersoll-Rand Company, 11 Broadway, New York, N. Y., has developed a line of high-speed pneumatic chipping hammers. A feature is the use of a plate valve of the flapper type. This valve, being a thin beveled plate, permits the hammers to be made shorter and lighter. The valve flaps down on its seat in a valve box to close the air ports, and rises to open them.

Another feature is the throttle valve, a combination piston and poppet type, that gives very fine graduation of port openings.

Open-type handles are standard equipment. The handles screw on the barrels and are securely locked in place by a pinch bolt arrangement. The ex-



Ingersoll-Rand Chipping Hammers

haust is through the side of the barrel and can be deflected in any desired direction by means of an adjustable deflector.

The hammers are furnished in five sizes as follows: size 000, ¾-in. stroke; size 100, 1-in. stroke; size 200, 2-in. stroke; size 300, 3-in. stroke; and size 400, 4-in. stroke.

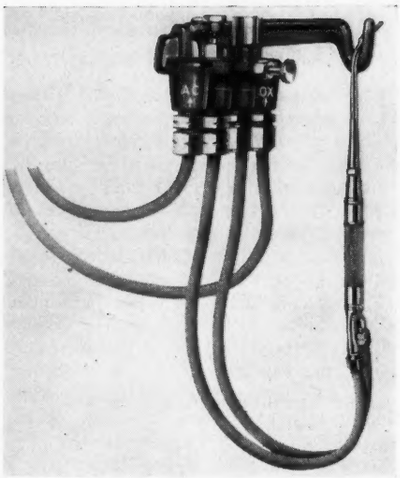
Heppenstall Changes Name

THE Heppenstall Forge & Knife Company, Pittsburgh, Pa., announces that it has changed its name to Heppenstall Company.

Bastian-Blessing Automatic Shut-Off for Welding Gases

A SHUT-OFF for welding gases known as the Rego "Economizer," has been placed on the market by the Bastian-Blessing Company, 240 E. Ontario St., Chicago, Ill. By the use of such a device no gas is burned while the operator is setting up the work and no gas is wasted while readjusting the flame. As soon as the welding torch is lifted from the torch arm a neutral flame is obtained.

Both shut-off valves in the economizer are of the diaphragm type. The



Bastion-Blessing Rego "Economizer" Automatic Shut-off for Welding Gases

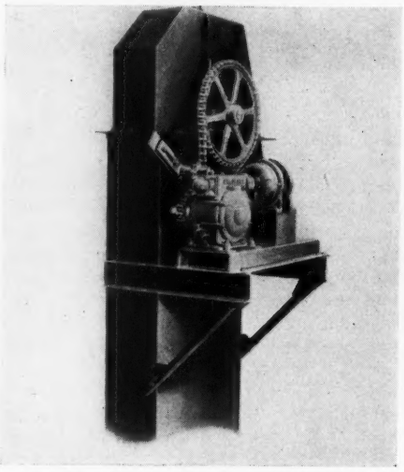
arm body in the diaphragm bonnet is of forged brass. Another feature is the lava tip which draws sufficient air into the acetylene before ignition to produce complete combustion. A simple wall bracket may be supplied for holding the Economizer and the various tips.

Caldwell Standardized Elevator Drive

A STANDARDIZED drive for elevators has just been announced by the H. W. Caldwell & Son Company, Chicago, Ill. It is built to operate centrifugal discharge, perfect discharge, or continuous bucket elevators requiring 3 to 15 hp. The entire line is standardized and carried in stock.

The first reduction is a fully-inclosed worm-gear speed reducer to which a motor is coupled. Motor and the worm reducer are on a welded steel base easily supported on the elevator casing or platform.

The second reduction in speed is made by a roller chain drive which also acts as a flexible connection between the reducer and head shafts.

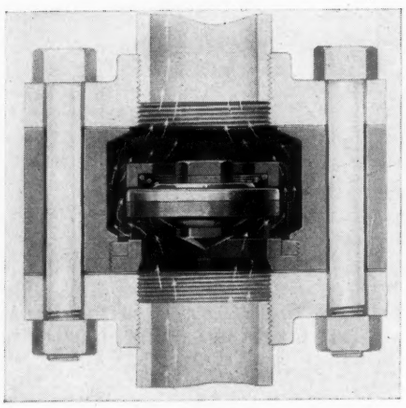


Caldwell Standardized Elevator Drive

Williams Noiseless Check Valve

A FLOATING check valve that will operate noiselessly in any position for pressures up to 1,000 lb., and with all working parts removable and renewable, has been brought out by the Valve Division of the Williams Gauge Company, 343 S. Dearborn St., Chicago, Ill. It occupies only 2½ to 4½ in. in the line, for pipe sizes ranging from 1 to 6 in. in diameter. Being built of metal to suit the service, it is applicable for use in vacuum heating systems, boiler-feed lines, house supply lines, air compressor lines, oil, gasoline, and chemical lines.

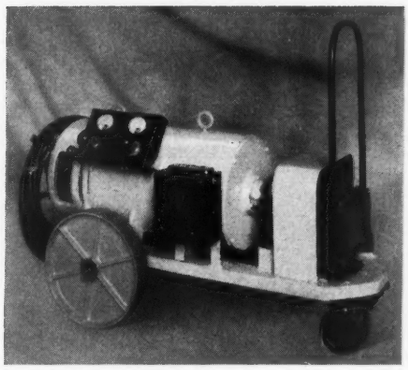
The check valve consists of a heavy cylindrical body of cast iron or steel with trim of government bronze or nitralloy for higher temperatures and pressures. The valve mechanism consists of a three-point guide cage that screws into the body; a self-cleaning valve disk with tapered holder to guide the flow; a renewable seat that also screws into the body; and a beehive spring to hold the valve disk to its seat. Sizes ranging from 1 to 6 in. are available, larger valves being made to order.



Williams Noiseless Check Valve

Fusion "Carb-O-Flux" Arc-Welding Generator

TO supply current for the "Carb-O-Flux" arc-welding process, which is a combination of a carbon welding arc and a fluxed wire or rod, the generator illustrated has been placed on the market by the Fusion Welding Corporation, 103rd St. and Torrence Ave., Chicago, Ill. The process is applicable to mild steels, aluminum, copper, and some alloy steels. The characteristic difference between this process and that of straight carbon arc is that the Carb-O-Flux arc, when applied to steel, pulls off from the hottest spot on the deposited metal, whereas the straight carbon arc tends to seek the colder edges. It is claimed that although there is ordinarily a 40-volt drop across the regular carbon arc, there is only a 20-volt drop across this arc, which necessitates the liberation of less heat. The tendency to burn through on thin sheets of any metal is therefore reduced.



Carbo-O-Flux Welding Generator

It is necessary for the welder to wear a face mask when using this process. A very steady hand is also a requisite for successful welding, and, on this account, women operators have been found quite adaptable.

On the heavier sections it is claimed that the Carb-O-Flux process will cut down the welding time to about one-third, while on the lighter materials the welding time can be cut in two. In addition, the welding cost can be cut from 25 to 75 per cent, depending upon the job. It is especially suitable for aluminum sheet welding, for which, it is claimed, joint efficiencies of 100 per cent can be obtained practically all the time. The welds are strong and also ductile. Sheet steel can be crimped crosswise of the head of such welds without cracking, and the welds in steel will also take enameling readily.

The Carb-O-Flux electric generator is available for a.c., three-phase, 60-cycle, 220- or 440-volt circuits, but it can be furnished for other drives such as belt drive from the line shaft, d.c. operation, and also a.c. operation from 25- to 50-cycle circuits, as well as for two-phase circuits. Direct gas-engine drive can also be supplied. All of these, except the three-phase 60-cycle drive, are special and must be built to order.

The accessories consist of a cable with proper lugs for attaching an electrode holder, a ground clamp, and a helmet equipped with proper lenses. Most of these accessories are designed especially for this process. The necessary supplies consist of specially designed welding wire of the proper metal and size for the work under consideration, and the right carbons.

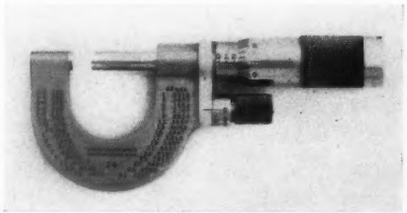
General Refractories Company Acquires Evens & Howard Refractories Properties

THE General Refractories Company, Philadelphia, Pa., announces that it has acquired all of the refractories properties of the Evens & Howard Fire Brick Company, of St. Louis, Missouri.

The Evens & Howard Fire Brick Company refractory plants will be operated by the General Refractories Company as the Evens & Howard Division. The sewer pipe operations of the Evens & Howard Fire Brick Company will be continued in operation by this company as formerly.

Brown & Sharpe Micrometer Caliper No. 24

FOR measuring to ten-thousandths of an inch micrometer caliper No. 24 is announced by the Brown & Sharpe Manufacturing Company, Providence, R. I. This tool, with a range of from 0 to 1 in. by ten-thousandths, reads the ten-thousandth parts of an inch direct. The thousandths are read from the barrel and thimble in the regular manner and the readings in ten-thousandths of an inch are read directly from the small lower thimble.



Brown & Sharpe Micrometer Caliper No. 24

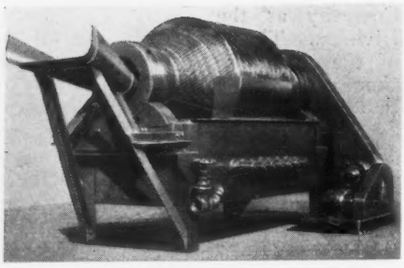
This tool is used and operated in much the same way as the conventional, 1-in. micrometer. After the spindle has been brought up to the object to be measured, the small lower thimble is turned until the horizontal line on the barrel of the micrometer coincides with a graduation on the main thimble. The graduation on the small lower thimble then tells the ten-thousandths of an inch to be added to the thousandths reading.

Hobart Industrial Washers

SUBSTANTIAL improvements in the standard model 318-C Hobart industrial washer and the addition of a rotary drum type, Model RD-24 SP, to its line have been announced by the Hobart Manufacturing Company, Industrial Washer Division, Troy, New York.

Among the improvements shown by the standard model 318-C are: A completely inclosed conveyor which eliminates dripping or sloppy conditions

Hobart Model 318-C Industrial Washer



Hobart Model RD-24SP Industrial Washer

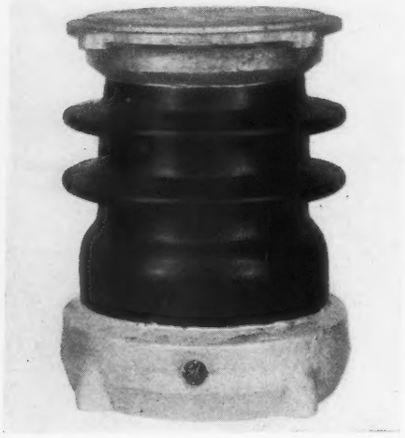
surrounding a machine; outside mounting of all pumping and driving mechanism which further eliminates vibration of the machine, makes these parts accessible, prevents any heating of the motors, and gives larger tanks that are in balanced capacity ratio with the specially designed pump; and a side sediment tank with removable strainers, allowing ready removal of foreign materials from the cleaning solution while the machine is in operation. The sediment tank is so designed that the cleaning solution, which is used over and over, upon entering the main tanks, passes over the heating element, thus maintaining a constant solution temperature with the least consumption of fuel.

In the rotary type, parts are shoveled or poured into the loading hopper and are automatically carried through the hot washing solution by a helical spiral flight conveyor, welded to the inside of the drum. The slight tumbling of the work sufficiently agitates the washing solution so that every surface of the most intricate shaped piece is thoroughly cleaned. While the unit shown is equipped with electrical immersion heaters other heating media may be used.

General Electric "Thyrite"

A MATERIAL that is both an insulator and a conductor was announced recently by the General Electric Company, Schenectady, N. Y. This material which has been called "Thyrite," meaning gate or valve, has the property of changing its resistance to the flow of electricity as the voltage or pressure is changed. The change in resistance is such that each time the applied voltage is doubled the resistance decreases so that the current flow is increased more than 12 times.

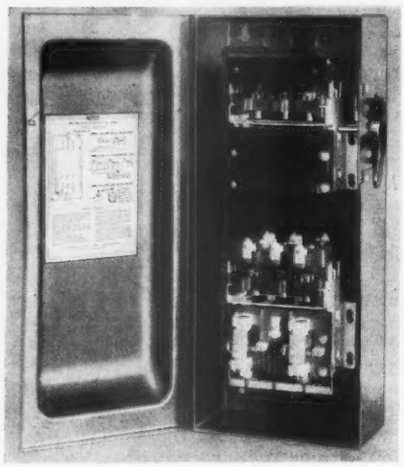
The resistance change of this material does not depend on the temperature, but on a change in the applied voltage. It resembles black slate in color and has mechanical properties similar to those of dry-process porcelain. In manufacturing it, the material is molded to the shape required and the contact surfaces are coated with metal by the Schoop process.



11,500-Volt "Thyrite" Lightning Arrester Unit

Condit Motor Starters with Motor Circuit Switches

CONDIT Electrical Manufacturing Corporation, Boston, Mass., announces that its standard a.c. across-the-line air motor starters may now be furnished equipped with a hand-operated motor circuit switch as required by National Electrical Code. For further security, both the starter and motor circuit switch will open the same overload.



Condit Motor Starters with Motor Circuit Switches

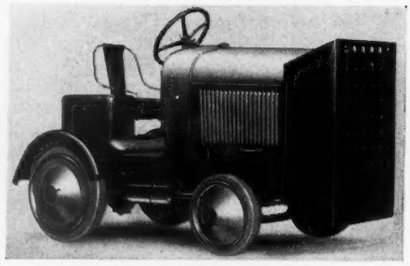
The starters are furnished with or without fuse clips and meter test jacks. The meter test jacks permit the motor to be tested for load without interfering with machine operation.

The starters are furnished in sizes up to 20 hp., 550 and 440 volts, 10 hp., 220 volts, and 5 hp., 110 volts.

Whitehead & Kales "Industrial Tug"

A GASOLINE tractor, known as the "Industrial Tug," has been introduced by the Whitehead & Kales Company, Detroit, Mich. All wearing parts are standard Ford AA truck parts.

The industrial tug has a drawbar pull of approximately 1,500 lb. Extra weights, totaling 670 lb., can be added to the rear of the frame, which will increase the drawbar pull 400 lb. Timken roller bearings are used throughout.



W. & K. Industrial Tug

Lubrication is by means of a Zerk system. The height is 56½ in., length 96 in., width 52 in., with a wheelbase of 48 in. The turning radius is 98 in. The weight on the rear wheels is approximately 1,500 pounds.

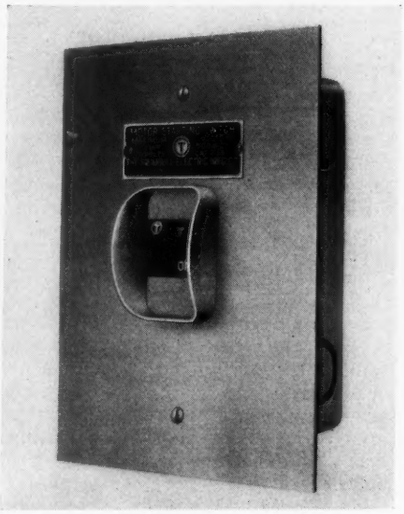
Detroit Steel Products Purchased Holorib

THE Detroit Steel Products Company, Detroit, Mich., maker of Fenestra steel windows, purchased Holorib, Inc., Cleveland, Ohio, including all manufacturing rights and patents to its product, Holorib insulated roof deck.

Trumbull Tumbler Switch

THE Trumbull Electric Manufacturing Company, Plainville, Conn., is now marketing a three-pole flush-mounting tumbler switch, Catalog No. 2361, with ratings of 30 amp., 125 to 250 volts, and 3 amp., 600 volts.

This switch is the same as the regular No. 2361 tumbler switch except that it is designed for flush mounting. Outside box sizes are 6½ in. high by 4 7/16 in. wide by 2 3/16 in. deep. Front plate dimensions are 7⅝ in. high by 5⅝ in. wide. Standard mounting holes are cut in the rear of the box.

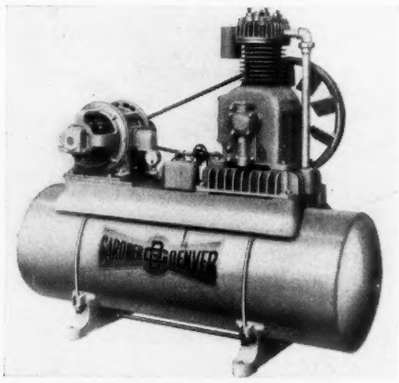


Trumbull Flush Mounting Tumbler Switch

Gardner-Denver Single-Stage Compressor

AN air-cooled single-stage compressor has just been placed on the market by the Gardner-Denver Company, Quincy, Ill. This unit is known as the A-C-E Model. It consists of a 3½x4-in. duplex compressor and a 5-hp. motor mounted on a cast-iron base on top of the air receivers. The unit has a displacement of 26 cu. ft. per min. at a speed of 600 revolutions per minute.

The suction and discharge valves, heat-treated and ground-steel disks, are inclosed in separate compartments. An automatic or hand-operated, start-and-stop control is furnished as standard equipment and operated in conjunction with a Penn type pressure and moisture unloader. The unloader is set to cut in at 130 lb. and out at 165 lb. Lubrication is by means of a controlled splash system. A positively driven plunger pump on the outside of the



Gardner-Denver Single-Stage Compressor

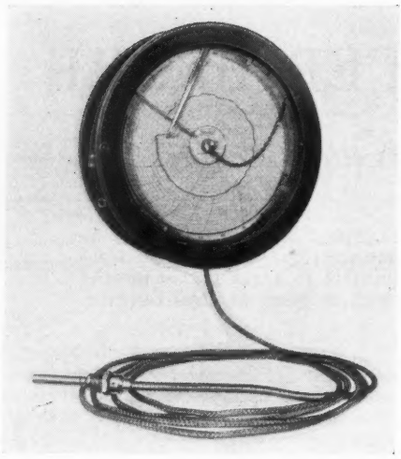
crank-case feeds filtered oil to the troughs under the connecting rods and a special oil ring and groove on the piston prevents oil from passing over to the discharge lines. An oil level indicates the amount of oil in the reservoir.

Other features of this compressor are: V-type belt drive; a fan-type flywheel; Hyatt type roller bearings; after-cooler in the base; and a muffler for the suction opening.

Moto Meter Recording Thermometer

A RECORDING thermometer, capable of charting temperatures from —40 to +750 deg. F., has been perfected by the Moto Meter Gauge & Equipment Corporation, Long Island City, N. Y. It is known as the Model 1000 "Motoco" recording thermometer.

In design, the instrument consists of a dust-, fume-, and moisture-proof housing which incloses the working parts. The element consists of a bulb, capillary tube, and Bourdon tube, filled solidly with a special liquid which has a coefficient of expansion uniform over the entire scale range. When the bulb is subjected to heat or cold the liquid



Moto Meter Recording Thermometer

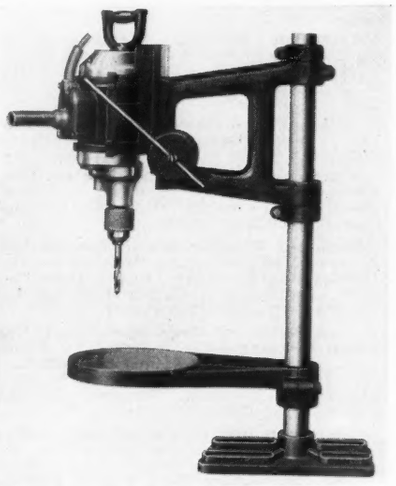
content therein expands or contracts and this action is transmitted through the capillary tubing to the Bourdon tube, causing the latter to wind or unwind and move a pen across the face of a chart actuated by a 24- or a 7-hr. clock mechanism.

The ratio between the pressure of the liquid and the movement of the pen is one to one, so that levers, hair springs, screws, gears, and other delicate parts are eliminated. A compensating spring takes up any difference between the bulb and room temperature and automatically resets the pen at the point on the chart corresponding with the bulb temperature.

Hisey-Wolf Radial Drilling Stand

A RADIAL drilling stand with sensitive feed, designed to handle all Hisey portable electric drills up to and including ⅞-in. capacity, has been introduced by The Hisey-Wolf Machine Company, Cincinnati, Ohio.

The lever feed is operated through rack and pinion the same as a drill press, thereby permitting positive and



Hisey-Wolf Drilling Stand with Sensitive Feed

sensitive control without fatigue to the operator. The motor holding brackets are so designed that the drill can be attached without removing a single part of the machine.

Martindale Lathe-Type Undercutter

THE Martindale Electric Company, 1260 West Fourth St., Cleveland, Ohio, announces the Martindale lathe-type undercutter. This is a heavy-duty, motor-driven unit designed to be mounted on a lathe.

The cutting spindle is provided with check nuts for taking up wear. Motor adjustment of 2 in. in and out can be made by loosening binding screws located on the top of the motor housing.

Stops for adjusting the position and

Martindale Lathe Type Undercutter

length of the cut are provided, as is a handwheel for raising and lowering the saw to its correct cutting depth. The saw may be used for cutting either U or V shaped slots.

Stoody "Borod" Welding Rod for Hard Facings

TO give, in a hard facing, resistance to abrasion comparable only to tungsten carbide, the "Borod" welding rod has been developed by the Stoody Company, Whittier, Calif. This rod consists of a soft steel sheath or outer wrapper in which is held an intimate mixture of fine grains of tungsten carbide and other alloys held in place by a suitable binder. When melted down by the heat of either the electric arc or the oxy-acetylene flame, Borod forms a hard wearing surface. The soft steel sheath, with its lower melting point, fuses first, and, as it melts, carries with it the particles of tungsten carbide. Part of the tungsten and part of the carbon of the tungsten carbide unite with the iron to form a tungsten-iron-carbon alloy, which intermingles with the iron and steel.

TRADE LITERATURE

You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog desired, as given in these columns.

(31) ARC WELDING—"General Specifications for Structural Arc Welding," Plate II of the series, "Studies in Structural Arc Welding."—The Lincoln Electric Company, Cleveland, Ohio.

(32) RESISTANCE INSTRUMENTS—Bulletin 300, Types COM, GOM, SOM Ohmmeters and HTD Circuit Tester.—Roller Smith Company, 233 Broadway, New York, N. Y.

(33) AMMETER—Leaflet 20400, the application, operation and construction of the Type PY-5 motor starting ammeter.—Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa.

(34) WASHFOUNTAINS—"Are Users Satisfied," a booklet on washfountains.—Bradley Washfountain Company, 2203 Michigan St., Milwaukee, Wis.

(35) FLEXIBLE SHAFTING — "Flexible Shaft Handbook"—120 pages devoted to application, characteristics, and construction of flexible shafts including installation views and reference tables.—The S. S. White Dental Manufacturing Company, 152 West 42nd St., New York, N. Y.

(36) HEATING—Bulletin 130, Tallmadge system of zone heating.—Webster Tallmadge & Company, 50 Church St., New York, N. Y.

(37) ALLOYS—"Properties of Haynes Stellite," a general description of Haynes Stellite alloys with an explanation of red hardness, uses, physical and chemical properties, and structures of these alloys.—Haynes Stellite Company, Kokomo, Ind.

(38) LATHE ATTACHMENTS — Bulletin No. 77 describes and illustrates lathe attachments.—South Bend Lathe Works, South Bend, Ind.

(39) OXY-ACETYLENE WELDING—"Oxwelded Construction for Modern Piping Services," the oxy-acetylene welding process for the fabrication of steel and wrought-iron piping systems.—The Linde Air Products Company, 30 East 42nd St., New York, N. Y.

(40) MILL MOTORS—Leaflet GEA-714B, MD-400 d.c. mill motors, MD inclosed, MDP protected, MDS open types.—General Electric Company, Schenectady, N. Y.

(41) UNIT HEATERS—Bulletin, 16 pages, Type UA unit heaters.—Skinner Bros. Manufacturing Company, Inc., 1474 So. Vandeventer St., St. Louis, Mo.

(42) VIBRATING SCREEN—16-page catalog of construction details, dimensions, capacity data, and installation photographs.—Stephens-Adamson Manufacturing Company, Aurora, Ill.

(43) INSTRUMENTS—Bulletin No. 210, portable d.c. ammeters, milli-ammeters, voltmeters, milli-voltmeters, volt-ammeters, galvanometers, circuit testers, shunts, multipliers.—Roller Smith Company, 233 Broadway, New York, N. Y.

(44) UNIT HEATERS—Folder on McQuay Radiator Corporation, 35 E. Wacker Drive, Chicago, Ill.

(45) TRADE STANDARDS—Fourth Edition, "Trade Standards of The Compressed Air Society" on nomenclature and terminology relating to air compressors and their operations; description of the low-pressure nozzle test recommended by the society; installation and care of air compressors, and recommendations for their lubrication; numerous tables, and a partial list of applications of compressed air.—The Compressed Air Society, 90 West St., New York, N. Y.

(46) ARC WELDING—Folder GEA-881C, G. E. Type WD-200A arc welder, Continental gas-engine driven.—General Electric Company, Schenectady, N. Y.

Coming Events

National Industrial Equipment Exposition—The first national industrial equipment exposition will be held in the Hotel Stevens, Chicago, March 3 to 7, 1930. Management, Midwestern Engineering Exposition, 308 West Washington St., Chicago, Ill.

American Society of Mechanical Engineers — Materials - Handling meeting, March 3 to 7, 1930. Hotel Stevens, Chicago, Ill.

American Society of Mechanical Engineers—Fiftieth Anniversary, April 5-9, 1930. New York, Hoboken and Washington.

American Welding Society — Annual meeting at society headquarters in New York City, April 22 to 25. Secretary, M. M. Kelly, 33 W. 39th St., New York City.

National Fire Protection Association—1930 annual meeting, May 12, Atlantic City, N. J.

American Society of Mechanical Engineers—Semi-annual meeting of the Society, June 9 to 12, 1930. Hotel Book-Cadillac, Detroit, Mich.

National Electric Light Association—Annual Convention at Municipal Auditorium, San Francisco, Calif., June 16-20, 1930. Secretary, A. J. Marshall, 420 Lexington Ave., New York City.

Association of Iron and Steel Electrical Engineers—Iron and Steel Exposition. Broadway Auditorium, Buffalo, N. Y., June 16 to 20 incl. John F. Kelly, Managing Director, Empire Building, Pittsburgh, Pa.

American Institute of Electrical Engineers—Annual Summer convention, June 23 to 27, Toronto, Ont. Annual Pacific Coast convention, Sept. 2 to 5, Portland, Ore.

(47) ARC WELDING—Arc Welding Data No. 11, "The Arc Welding of Cast Iron," covering some of the properties of cast iron and recommended procedure to be followed in arc welding.—Westinghouse Electric and Manufacturing Company, E. Pittsburgh, Penn.

(48) SHOVEL—Form 222, Trackson tractor shovel for excavating.—Trackson Company, 500 Clinton St., Milwaukee, Wis.

(49) RECORDING GAGES—Bulletin 1009, recording pressure and vacuum gages. Index to Bulletin 1009, list of charts available for use with these gages.—Bristol Company, Waterbury, Conn.

(50) POWER FACTOR—A graphic method involving simple computations is described in publication GET-191, "Industrial Power-Factor Problems Solved by Scale."—General Electric Company, Schenectady, N. Y.

(51) SYNCHRONOUS MOTORS — Bulletin GEA-1191, 88 pages.—General Electric Company, Schenectady, N. Y.

(52) TRUCK BODIES—Bulletin 65, Movable V concrete body.—The C. O. Bartlett & Snow Company, 6200 Harvard Ave., Cleveland, Ohio.

(53) CAPACITORS — "Capacitors for Power Factor Correction" described in circular 1670-B, 20 pages.—Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa.

(54) CIRCUIT BREAKERS—Folder GEA-878A on station oil circuit breakers; Types FK-330, FHK-330, 15,000 to 25,000 volts, 600 to 4000 amperes.—General Electric Company, Schenectady, N. Y.

(55) TEMPERATURE REGULATOR—16-page bulletin on Stat-Amatic temperature regulators for industrial plants.—Stat-Amatic Instrument & Appliance Company, Hartford, Conn.

(56) PUMP SELECTION CHARTS—Bulletin 200, centrifugal pump selection charts with a complete description of the Goulds line of horizontally split, inclosed-impeller, single - stage, double - suction pumps.—Goulds Pumps, Inc., Seneca Falls, N. Y.

(57) POWER TRANSMISSION — Flexible couplings, bulletin No. 37, design and application. Speed reducers, and power transmission service.—Morse Chain Company, Ithaca, N. Y.

(58) MOTORS—Bulletin 205, Type T heavy-duty planer motors for reversing service.—The Reliance Electric & Engineering Company, 1042 Ivanhoe Road, Cleveland, Ohio.

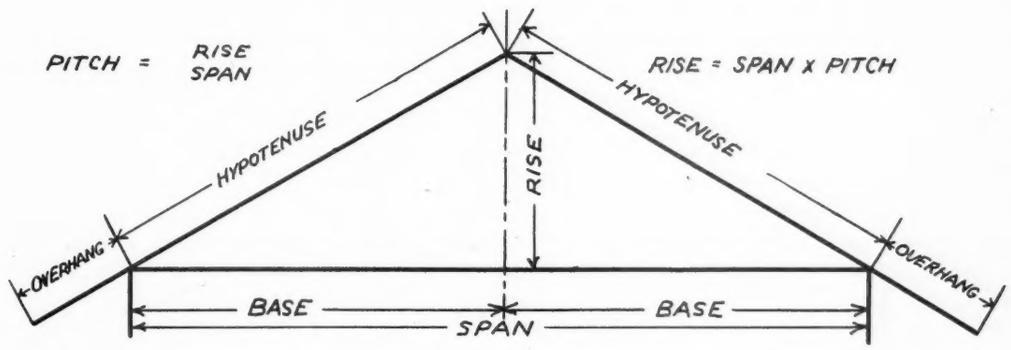
(59) TEXROPE DRIVES — Booklet, 28 pages, application of this transmission medium in various industries.—Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

(60) MOTORS—Bulletin GEA-1158A, "An Easy Method of Determining the Cost of Operating Electric Appliances and Motors."—General Electric Company, Schenectady, N. Y.

(61) OIL PURIFIER—Leaflet No. 20442, combination Sharples centrifuge and filter-press oil purifier. — Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa.

INDUSTRIAL ENGINEERING'S DATA SHEETS

How to Find Length of Slope of Roof When Pitch and Base Are Known



Pitch of Roof	Rise Per Foot in Inches	
1/48	½	Base × 1.00086 = Hypotenuse
1/24	1	Base × 1.00346 = Hypotenuse
3/48	1½	Base × 1.00777 = Hypotenuse
1/12	2	Base × 1.01379 = Hypotenuse
5/48	2½	Base × 1.02149 = Hypotenuse
⅛	3	Base × 1.03077 = Hypotenuse
7/48	3½	Base × 1.04165 = Hypotenuse
1/6	4	Base × 1.05409 = Hypotenuse
3/16	4½	Base × 1.06800 = Hypotenuse
1/5	4 4/5	Base × 1.07703 = Hypotenuse
5/24	5	Base × 1.08333 = Hypotenuse
11/48	5½	Base × 1.10003 = Hypotenuse
¼	6	Base × 1.11803 = Hypotenuse
13/48	6½	Base × 1.13728 = Hypotenuse
7/24	7	Base × 1.15770 = Hypotenuse
5/16	7½	Base × 1.17758 = Hypotenuse
1/3	8	Base × 1.20185 = Hypotenuse
17/48	8½	Base × 1.22545 = Hypotenuse
⅜	9	Base × 1.25000 = Hypotenuse
19/48	9½	Base × 1.27543 = Hypotenuse
2/5	9 3/5	Base × 1.28064 = Hypotenuse
5/12	10	Base × 1.30170 = Hypotenuse
7/16	10½	Base × 1.32876 = Hypotenuse
11/24	11	Base × 1.35656 = Hypotenuse
23/48	11½	Base × 1.38506 = Hypotenuse
½	12	Base × 1.41421 = Hypotenuse

Pitch of Roof	Rise Per Foot in Inches	
25/48	12½	Base × 1.44157 = Hypotenuse
13/24	13	Base × 1.47431 = Hypotenuse
27/48	13½	Base × 1.50518 = Hypotenuse
7/12	14	Base × 1.53659 = Hypotenuse
3/5	14 2/5	Base × 1.56205 = Hypotenuse
29/48	14½	Base × 1.56846 = Hypotenuse
⅝	15	Base × 1.60078 = Hypotenuse
31/48	15½	Base × 1.63352 = Hypotenuse
2/3	16	Base × 1.66666 = Hypotenuse
11/16	16½	Base × 1.70018 = Hypotenuse
17/24	17	Base × 1.73405 = Hypotenuse
35/48	17½	Base × 1.76825 = Hypotenuse
¾	18	Base × 1.80277 = Hypotenuse
37/48	18½	Base × 1.83759 = Hypotenuse
19/24	19	Base × 1.87268 = Hypotenuse
4/5	19 1/5	Base × 1.88679 = Hypotenuse
39/48	19½	Base × 1.90804 = Hypotenuse
5/6	20	Base × 1.94365 = Hypotenuse
41/48	20½	Base × 1.97949 = Hypotenuse
⅞	21	Base × 2.01556 = Hypotenuse
43/48	21½	Base × 2.05184 = Hypotenuse
11/12	22	Base × 2.08832 = Hypotenuse
15/16	22½	Base × 2.12500 = Hypotenuse
23/24	23	Base × 2.16185 = Hypotenuse
47/48	23½	Base × 2.19887 = Hypotenuse
1	24	Base × 2.23606 = Hypotenuse

Example: Find length of slope of roof to be covered—Same having 1/3 pitch, 36 ft. base, and 2 ft. overhang

1.20185 given in table for 1/3 pitch
36
721110
360555
Hypotenuse 43.26660 = 43 ft. 3 3/16 in. approximately

43 ft. 3 3/16 in. + 2 ft. overhang = 45 ft. 3 3/16 in.
End laps must be added to this length

Courtesy of the American Rolling Mill Company, Middletown, Ohio.

INDUSTRIAL ENGINEERING'S DATA SHEETS

Crane Inspection Report

Location _____ Crane No. _____ Date _____

Write condition found using Key.

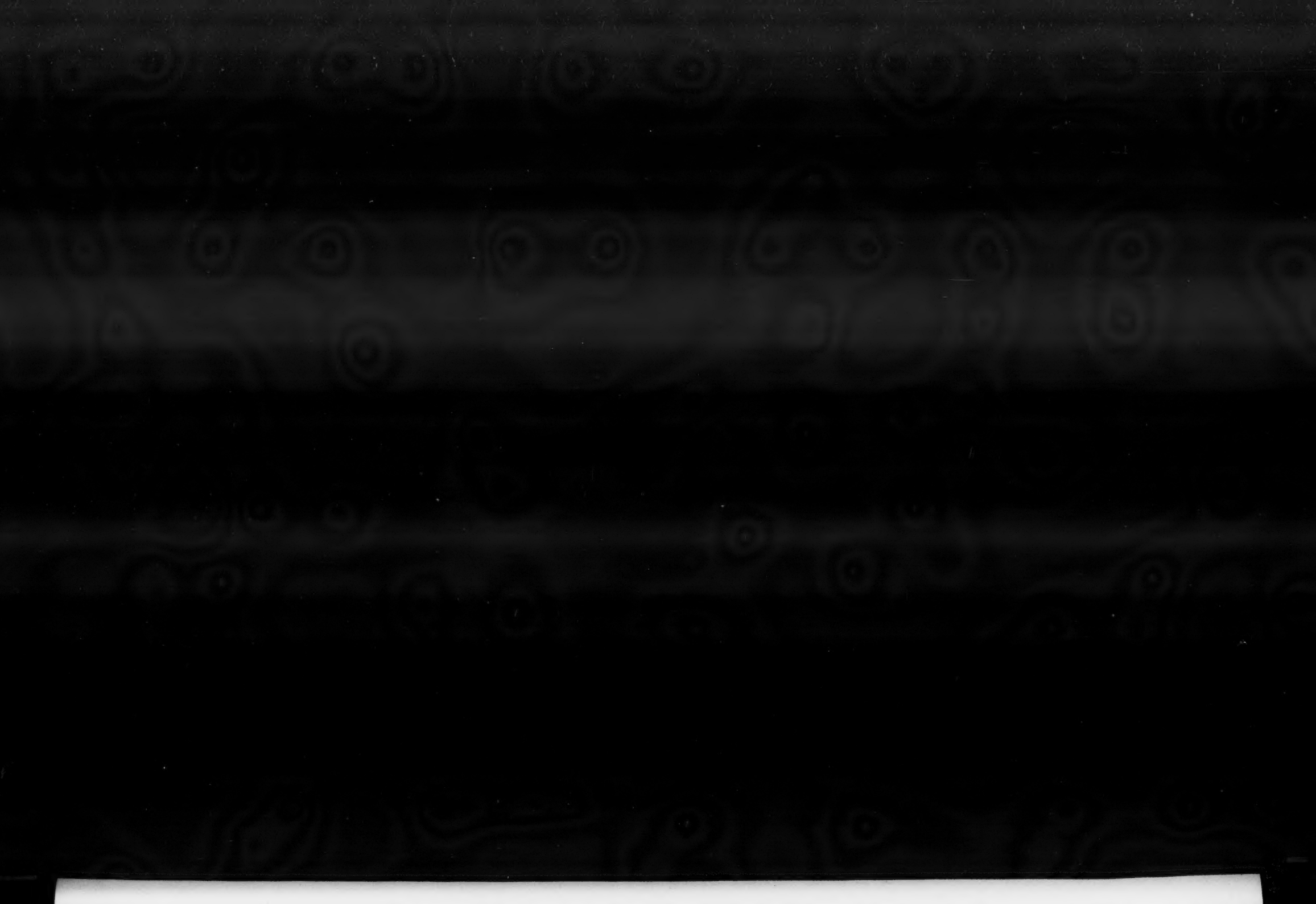
KEY: OK, Good, Fair, Worn Badly, Attention, Change, Loose, Tight, Dirty, Clean, Adjust, Tension, Burned, Bent.

MOTOR PARTS	ARMATURE	COMMUTATOR	FIELD	BRUSHES	B. HOLDERS	BEARING	GREASE OIL	ROTOR	STATOR	GEARS PINIONS
Bridge Motor										
Hoist Motor										
Aux. Hoist Motor										
Rack Motor										

CONTROLLER PARTS	BRUSHES	B. HOLDERS	FINGER	CONTACTS	LEVERS	RESISTANCE	BOLTS	WIRING	
Bridge Controller									
Hoist Controller									
Aux. Hoist Controller									
Rack Controller									

Knife Switches	Bridge Track Wheels	End Trucks
Limit Switches	Trolley Track Wheels	Gear Guards
Safety Switches	Bridge Axle Bushing	Cage
Fuse Clips	Trolley Axle Bushing	Bolts and Rivets
Relays	Traverse Bushing	Railings
Electric Brake	Bearing (not motor)	Walks
Mech. Brake	Drums	Sanders
Foot Brake	Drum Gear	Bumpers
Main Collector Shoes	Drum Pinion	Windows
Trolley Collector Shoes	Bridge Gear	Gen. Wiring
Conductor Rails	Trolley Travel Gear	Ladders
Trolley Wires	Intermediate Gear	Stairways
Cables	Traverse Shaft	Grease Cups
Bottom Blocks	Main Hoist Shaft	Crane Alignment
Top Blocks	Aux. Hoist Shaft	

Remarks: _____

Inspected by _____

From a report of the Hydraulic Power Committee, Engineering National Section, National Electric Light Association